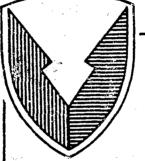
1133

193 153

A193 153







No. 13322

213)

210-HP DIESEL ENGINE ENDURANCE AND PERFORMANCE

TESTING WITH FIRE RESISTANT DIESEL FUEL

OCTOBER 1987

Reproduced From Best Available Copy

Milad H. Mekari
U.S. Army Tank-Automotive Command
ATTN: AMSTA-RGE

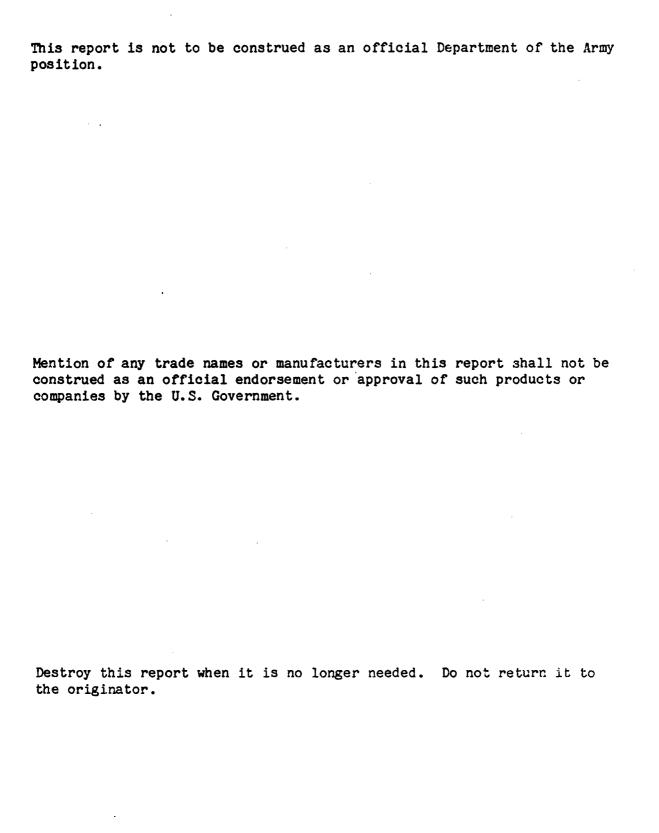
By Warren, MI 48397-5000

APPROVED FOR PUBLIC RELEASE: DISTRIBUTION IS UNLIMITED

U.S. ARMY TANK-AUTOMOTIVE COMMAND RESEARCH, DEVELOPMENT & ENGINEERING CENTER Warren, Michigan 48397-5000

20020806145

NOTICES



REPORT D	OCUMENTATIO	N PAGE			Form Approved OMB No. 0704-0188 Exp. Date: Jun 30, 1986					
1a. REPORT SECURITY CLASSIFICATION Unclassified		1b. RESTRICTIVE MARKINGS								
2a. SECURITY CLASSIFICATION AUTHORITY	**************************************	3. DISTRIBUTION/AVAILABILITY OF REPORT APPROVED FOR PUBLIC RELEASE:								
2b. DECLASSIFICATION / DOWNGRADING SCHEDU	LE	DISTRIBUTION IS UNLIMITED								
4. PERFORMING ORGANIZATION REPORT NUMBE	R(S)	5. MONITORING ORGANIZATION REPORT NUMBER(S)								
		13322								
6a. NAME OF PERFORMING ORGANIZATION U.S. Army Tank-Automotive	6b. OFFICE SYMBOL (If applicable)	7a. NAME OF MO	ONITORING ORGAI	NIZATION						
Command	AMSTA-RGE	<u> </u>	[ank-Automot		ommand					
6c. ADDRESS (City, State, and ZIP Code)		7b. ADDRESS (Cit	y, State, and ZIP (Code)						
Warren, MI 48397-5000		Warren, MI	48397-5000							
8a. NAME OF FUNDING/SPONSORING	8b. OFFICE SYMBOL		INSTRUMENT, IDE	NTIFICAT	ION NUMBER					
CRGANIZATION	(If applicable)			•						
8c. ADDRESS (City, State, and ZIP Code)	Andrew Control		UNDING NUMBER							
		PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.	WORK UNIT ACCESSION NO.					
11. TITLE (Include Security Classification)	<u> </u>	<u> </u>								
210-HP Diesel Engine Endurance	and Performance	Testing with	n Fire Resis	tant I	Diesel Fuel (U)					
12. PERSONAL AUTHOR(S) Mekari, Milad H.										
13a. TYPE OF REPORT 13b. TIME CO	OVERED 1-86 TO7-29-87	14. DATE OF REPORT	RT (Year, Month, I	Day) 15	. PAGE COUNT 276					
	y order for rein			elvoir						
CON: WI-6-60030-IB-IB, A6418										
17. COSATI CODES FIELD GROUP SUB-GROUP	18. SUBJECT TERMS (6 Fire resistant									
FIELD GROOF SUB-GROOF	percent, mixing	g system, sto	orage fuel t	ank, c	copper gasket,					
19. ABSTRACT (Continue on reverse if necessary	engine performa		rance tests	, bhp,	, SFC, cont.					
Four-hundred-hour endurance and performance tests were conducted at the U.S. Army Tank-Automotive Command on a production DT 466, 210-hp Navistar Diesel Engine with fire resistant diesel fuel (FRDF). The FRDF contained 10.2 to 13.2 volume percent tap water. The purpose of these tests was to determine the effects of fuel-water macroemulsion on engine starting, engine fuel-wetted parts, engine power output, deposit, wear and oil degradation. The results of these tests indicated that under laboratory-controlled conditions, there are no engine starting problems, deposits, oil degradation or abnormal wear.										
A significant loss in horsepower (12 percent) occurred at the start of the 400-hour test when the engine ran with FRDF containing 10.4% volume water. A significant loss in horse-power (13.36 percent) occurred at the end of the 400-hour test when the engine ran with FRDF containing 12% volume water. A significant increase (18 percent) in specific fuel consumption occurred at the start of										
20. DISTRIBUTION / AVAILABILITY OF ABSTRACT		21. ABSTRACT SEC Unclassifie		TION	cont.					
UNCLASSIFIED/UNLIMITED SAME AS R 22a. NAME OF RESPONSIBLE INDIVIDUAL Milad H. Mekari	PT. DTIC USERS	22b. TELEPHONE (Include Area Code) 22c. OFFICE SYMBOL (313) 574–5796 AMSTA-RGE								

DD FORM 1473, 84 MAR

Item 18. continued.

dynamometer, emulsifier, diesel fuel (DF2).

Item 19. continued.

the test when the engine ran with FRDF containing 10.4 percent volume water. The specific fuel comsumption increased to 23.91 percent when the engine ran at the end of the 400-hour test with FRDF containing 12 percent volume water.

The delivery valve gasket of the fuel injection pump failed due to erosion caused by the FRDF.

The engine maximum torque occurred at 1,940 rpm with FRDF versus 1,800 rpm with DF2.

SUMMARY

The following includes pertinent product information.

• Engine:

The test engine is a diesel, 6-cylinder in line, 210-hp, 2,600-rpm, direct injection, turbocharged, after cooled, model DT 466, serial number 176482. It is manufactured by Navistar International, USA.

• Dynamometer:

Made by Eaton, model no. 1014WIG, serial no. 67637-1, power range 250 hp, speed range 1,800 to 6,000 rpm.

• Mixer:

Manufactured by Milton Roy Company. The mixer consists of the following subsystems:

-DF2 pump of 91 gph outlet flow and 35 psi outlet pressure -water pump of 10.5 gph outlet flow and 35 psi outlet pressure -surfactant pump of 10.5 gph outlet flow and 35 psi outlet pressure

Motor

The motor which drives the pumps is manufactured by Reliance Electric Company. The motor's performance specifications are as follows: 1.5 hp, 3 phase, 1,725 rpm, 230/460 volts.

• Fire Resistant Diesel Fuel (FRDF):

The FRDF is specified for this test to contain 78% volume DF2, 12% volume surfactant and 10% volume tap water; however, due to the in-line blending system's inability to regulate the water level at the specified 10% volume, the actual test percentage volume of the water ranged from 10.2 to 13.2.

.

4

PREFACE

This work was funded by an intra-Army order for reimbursable service, USA, Belvoir, RDE Center. The FRDF and engine lubricant laboratory analyses were conducted by Belvoir Fuels and Lubricants Research Facility (SWRI).

TABLE OF CONTENTS

Section																									P	age
1.0.	INTRO	ODUCTI	ON	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	15
2.0.	OBJE	CTIVE.	•		•	•	•		•	•	•	•	•				•	•	•	•	•	•	•	•	•	15
3.0.	CONCI	LUSION	ıs.		•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	15
4.0.	RECO	1MENDA	TIC	NS.		•			•	•	•	•	•	•	•	•	•	•	•	•	•	•		•	.•	15
5.0.		JSSION																								16 16
5.1. 5.2.		Progr																								33
5.2.1.		power ase d																							- 1	
F 2 2	10.4	Perce	nt	Vol	.ume	e A	.dd	ed	Taŗ	W	at	er		•												33
5.2.2.	with	power DF2 v	s.	FRD	F	<i>i</i> it	h :	12	Per	ce	nt	V	ol	um	е	Ad	đе	d	Ta	p	Wa	ιte	er			34
5.2.3.		power																								
		ance																								34
5.3.		ection																								36
5.3.1.		Injec																								36
5.3.2.		les Op																								36
5.3.3.		ne Ins																								36
5.4.		and Fi																								38
5.5.	Horse	power	an	d I	orc	ļue	76	ers	us	rp	m	•	•	•	•	•	•	•	•	•	•	•	•	•	•	38
							_					.													_	_
APPENDIX		ANALY																								-T
APPENDIX	С В.	NATO																								
		SPECI																								
APPENDIX		SAMPL			_																					
APPENDIX		PHOTO																								
APPENDIX	(E.	DIMEN	SIC	NAL	. AN	IAL	YS:	IS.	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	E	-1
DISTRIBU	JTION	LIST.																						. I)is	t - 1

LIST OF TABLES

Table	Title	Page
5-1.	Engine Specification	17
5 - 2.	FRDF and DF2	18
5 - 3.	Dynamometer Specification	19
5-4.	Test Cell Preparation and Tests Outline	20
5 - 5.	Safety Shutdown Parameters	21
5 - 6.	Temperature Ranges of the Thermocouples	22
5 - 7•	Pressure Ranges of the Transducers	23
5-8.	WarningShutdown Temperatures	24
5-9.	WarningShutdown Pressures	25
5-10.	Engine Break-In Run	26
5-11.	Initial Engine Performance Test with DF2 Fuel	27
5 - 12.	Development of Part-Load Performance Data from Full-Load 100% Performance Run for DF2 Fuel	28
5-13.	Development of Part-Load Performance Data from Full-Load 100% Performance Run for FRDF	29
5-14.	400-Hour NATO Endurance Test with FRDF	30
5-15.	Instruments and Equipment	31
5-16.	Test Samples and Test Conclusion	32
5-17.	Brake Horsepower and Brake Specific Fuel Consumption of the Engine Using DF2 and FRDF	35
5-18.	Nozzles' Opening Pressure Inspection	37
5-19.	Performance Test Data (100% Load, DF2, 0-Hour)	39
5-20.	Performance Test Data (85% Load, DF2, 0-Hour)	40
5-21.	Performance Test Data (70% Load, DF2, 0-Hour)	41

LIST OF TABLES (Continued)

Table		•	Title	Page
5-22.	Performance	Test Data	(50% Load, DF2, 0-Hour)	. 42
5 - 23.	Performance	Test Data	(25% Load, DF2, 0-Hour)	. 43
5-24.	Performance	Test Data	(100% Load, FRDF, 0-Hour)	. 44
5-25.	Performance	Test Data	(85% Load, FRDF, 0-Hour)	. 45
5 - 26.	Performance	Test Data	(70% Load, FRDF, 0-Hour)	46
5-27.	Performance	Test Data	(50% Load, FRDF, 0-Hour)	47
5 - 28.	Performance	Test Data	(25% Load, FRDF, 0-Hour)	48
5 - 29.	Performance	Test Data	(100% Load, FRDF, 100-Hour)	49
5-30.	Performance	Test Data	(100% Load, FRDF, 200-Hour)	50
5-31.	Performance	Test Data	(100% Load, FRDF, 300-Hour)	51
5-32.	Performance	Test Data	(100% Load, FRDF, 400-Hour)	52
5 - 33.	Performance	Test Data	(100% Load, FRDF, 400-Hour)	53
5-34.	Performance	Test Data	(70% Load, FRDF, 400-Hour)	54
5-35.	Performance	Test Data	(50% Load, FRDF, 400-Hour)	55
5-36.	Performance	Test Data	(25% Load, FRDF, 400-Hour)	56
5-37.	Performance	Test Data	(100% Load, DF2, 400-Hour)	57
5-38.	Performance	Test Data	(85% Load, DF2, 400-Hour)	58
5-39.	Performance	Test Data	(70% Load, DF2, 400-Hour)	59
5-40.	Performance	Test Data	(50% Load, DF2, 400-Hour)	60
5-41.	Performance	Test Data	(25% Load, DF2, 400-Hour)	61
5-42.	Performance	Test Data	(100% Load, FRDF, 400-Hour)	62
5-43.	Performance	Test Data	(50% Load, FRDF, 400-Hour)	63
5-44.	Performance	Test Data	(Lubricating Oil Consumption)	64
5-45.	Performance	Test Data	(at the end of 10-Hour)	65

LIST OF TABLES (Continued)

Table					Ti	tle										F	age
5-46.	Performance	Test	Data	(at	the	end	of	20-Hour) .		•	•	•	•	•	•	•	66
5-47.	Performance	Test	Data	(at	the	end	of	30-Hour) .	•	•	•	•	•	•	•	•	67
5-48.	Performance	Test	Data	(at	the	end	of	40-Hour) .	,	•	•	•	•	•	•	•	68
5-49.	Performance	Test	Data	(at	the	end	of	50-Hour) .	,	•		•	•	•	•	•	69
5-50.	Performance	Test	Data	(at	the	end	of	60-Hour) .	,	•	•	•	•	•	•	•	70
5-51.	Performance	Test	Data	(at	the	end	of	70-Hour) .	•	•	•	•	•	•	•	•	71
5 - 52.	Performance	Test	Data	(at	the	end	of	80-Hour) .	,	•		•	•	•	•	•	72
5-53.	Performance	Test	Data	(at	the	end	of	90-Hour) .	•			•	•	•	•	•	73
5-54.	Performance	Test	Data	(at	the	end	of	100-Hour).	•	,	•	•	•	•	•	•	74
5 - 55.	Performance	Test	Data	(at	the	end	of	110-Hour).	•	•	•	•	•	•	•	•	7 5
5 - 56.	Performance	Test	Data	(at	the	end	of	120-Hour).		•	•	•	•	•	•	•	76
5-57.	Performance	Test	Data	(at	the	end	of	130-Hour).	•	•	•	•	•	•	•	•	77
5-58.	Performance	Test	Data	(at	the	end	of	140-Hour).	•	,	•	•	•	•	•	•	78
5-59.	Performance	Test	Data	(at	the	end	of	150-Hour).	•	,	•	•	•	•	•	•	79
5-60.	Performance	Test	Data	(at	the	end	of	160-Hour).	•	,	•	•	•	•	•	•	80
5-61.	Performance	Test	Data	(at	the	end	of	170-Hour).	•		•	•	•	•	•	•	81
5-62.	Performance	Test	Data	(at	the	end	of	180-Hour).	•	,	•	•	•	•	•	•	82
5-63.	Performance	Test	Data	(at	the	end	of	190-Hour).	•		•	•	•	•	•	•	83
5-64.	Performance	Test	Data	(at	the	end	of	200-Hour).	•		•	•	•	•	•	•	84
5-65.	Performance	Test	Data	(at	the	end	of	210-Hour).	•		•	•	•	•	•	•	85
5-66.	Performance	Test	Data	(at	the	end	of	220-Hour).	•		•	•	•	•	•	•	86
5-67.	Performance	Test	Data	(at	the	end	of	230-Hour).	•		•	•	•	•	•	•	87
5-68.	Performance	Test	Data	(at	the	end	of	240-Hour).	•		•	•	•	•	•	•	88
5-69.	Performance	Test	Data	(at	the	end	of	250-Hour).									89

LIST OF TABLES (Continued)

Table					Tit	le									F	age
5-70.	Performance	Test	Data	(at	the	end	of	260-Hour).	•	•	•	•	•	•	•	90
5-71.	Performance	Test	Data	(at	the	end	of	270-Hour).	•	•	•	•	•	•	•	91
5-72.	Performance	Test	Data	(at	the	end	of	280-Hour).	•	•	•	•	•	•	•	92
5-73.	Performance	Test	Data	(at	the	end	of	290-Hour).	•	•	•		•	•	•	93
5-74.	Performance	Test	Data	(at	the	end	of	300-Hour).	•	•	•	•		•	•	94
5-75.	Performance	Test	Data	(at	the	end	of	310-Hour).	•	•	•	•	•	•	•	95
5-76.	Performance	Test	Data	(at	the	end	of	320-Hour).	•	•		•	•	•	•	96
5-77.	Performance	Test	Data	(at	the	end	of	330-Hour).	•	•	•	•	•	•	•	97
5-78.	Performance	Test	Data	(at	the	end	of	340-Hour).	•	•	•		•	•	•	98
5-79.	Performance	Test	Data	(at	the	end	of	350-Hour).	•	•	•	•	•	•	•	99
5-80.	Performance	Test	Data	(at	the	end	of	360-Hour).	•	•	•	•	•	•	•	100
5-81.	Performance	Test	Data	(at	the	end	of	370-Hour).	•	•	•	•	•	•	•	101
5-82.	Performance	Test	Data	(at	the	end	of	380-Hour).		•		•	•	•		102
5-83.	Performance	Test	Data	(at	the	end	of	390-Hour).	•	•	•	•	•	•	•	103
5-84.	Performance	Test	Data	(at	the	end	of	400-Hour).	•	٠	•	•	•	•	•	104
5-85.	Properties	of Re	feren	ce D	iese	l Fu	els					•			•	105

LIST OF ILLUSTRATIONS

Figure	3			Title	Page
5-1.	Schematic F	low D	iagram o	f FRDF Blending System	. 106
5-2.	Performance	Test	Diagram	(100% Load, DF2, 0-Hour)	. 107
5 - 3.	Performance	Test	Diagram	(85% Load, DF2, 0-Hour)	. 108
5-4.	Performance	Test	Diagram	(70% Load, DF2, 0-Hour)	. 109
5 - 5.	Performance	Test	Diagram	(50% Load, DF2, 0-Hour)	. 110
5-6.	Performance	Test	Diagram	(25% Load, DF2, 0-Hour)	. 111
5-7.	Performance	Test	Diagram	(100% Load, FRDF, 0-Hour)	112
5-8.	Performance	Test	Diagram	(85% Load, FRDF, 0-Hour)	. 113
5-9.	Performance	Test	Diagram	(70% Load, FRDF, 0-Hour)	. 114
5-10.	Performance	Test	Diagram	(50% Load, FRDF, 0-Hour)	. 115
5-11.	Performance	Test	Diagram	(25% Load, FRDF, 0-Hour)	. 116
5-12.	Performance	Test	Diagram	(100% Load, FRDF, 100-Hour)	. 117
5-13.	Performance	Test	Diagram	(100% Load, FRDF, 200-Hour)	. 118
5-14.	Performance	Test	Diagram	(100% Load, FRDF, 300-Hour)	. 119
5-15.	Performance	Test	Diagram	(100% Load, FRDF, 400-Hour)	. 120
5-16.	Performance	Test	Diagram	(85% Load, FRDF, 400-Hour)	. 121
5-17.	Performance	Test	Diagram	(70% Load, FRDF, 400-Hour)	. 122
5-18.	Performance	Test	Diagram	(50% Load, FRDF, 400-Hour)	. 123
5-19.	Performance	Test	Diagram	(25% Load, FRDF, 400-Hour)	. 124
5-20.	Performance	Test	Diagram	(100% Load, DF2, 400-Hour)	. 125

LIST OF ILLUSTRATIONS (Continued)

Figure				Title	Pa	ge
5-21.	Performance	Test	Diagram	(85% Load, DF2, 400-Hour)	•	126
5-22.	Performance	Test	Diagram	(70% Load, DF2, 400-Hour)	•	127
5-23.	Performance	Test	Diagram	(50% Load, DF2, 400-Hour)	•	128
5-24.	Performance	Test	Diagram	(25% Load, DF2, 400-Hour)	•	129
5-25.	Performance	Test	Diagram	(100% Load, FRDF, 400-Hour)	•	130
5-26.	Performance	Test	Diagram	(50% Load, FRDF, 400-Hour)	•	131
5-27.	Performance	Test	Diagram	(HP at 100% Load for DF2 and FRDF).	•	132
5 - 28.	Performance	Test	Diagram	(SFC at 100% Load for DF2 and FRDF)	•	133
5-29.	Performance	Test	Diagram	(Torque at 100% Load DF2 and FRDF).		134
5-30.	Performance	Test	Diagram	(HP at 85% Load for DF2 and FRDF) .	•	135
5-31.	Performance	Test	Diagram	(SFC at 85% Load, for DF2 and FRDF)	•	136
5-32.	Performance and FRDF).		Diagram	(Torque at 85% Load, for DF2	•	137
5 - 33.	Performance	Test	Diagram	(HP at 70% Load, for DF2 and FRDF).	•	138
5-34.	Performance	Test	Diagram	(SFC at 70% Load, for DF2 and FRDF)		139
5-35.	Performance DF2 and FRDI		Diagram	(Torque at 70% Load, for	•	140
5-36.	Performance	Test	Diagram	(HP at 50% Load for DF2 and FRDF) .	•	141
5-37.	Performance	Test	Diagram	(SFC at 50% Load for DF2 and FRDF).	•	142
5-38.	Performance DF2 and FRD		_	(Torque at 50% Load for	•	143
5-39.	Performance	Test	Diagram	(HP at 25% Load for DF2 and FRDF) .	•	144
5-40.	Performance	Test	Diagram	(SFC at 25% Load for DF2 and FRDF).		145
5-41.				(Torque at 25% Load for DF2		146

1.0. INTRODUCTION

The test program and report were conducted and prepared by the U.S. Army Tank-Automotive Command Propulsion Systems Division and laboratory. The report details performance and durability tests using Fire Resistant Diesel Fuel (FRDF). The objective of the FRDF program is to develop a future fuel that will reduce the vulnerability of military vehicles to fire, decrease the number of vehicles lost and repair costs, and increase crew survivability.

2.0. OBJECTIVE

The objective of this project is to evaluate the performance and endurance of a medium-sized, unmodified commercial production diesel engine of 200-hp range tested with FRDF. The FRDF contains tap water of 10.2 to 13.2 percent volume.

Another objective of this project is to inspect the fuel-wetted parts of the fuel injection system and engine, and determine the effect of the water in the fuel on these parts.

3.0. CONCLUSIONS

The FRDF was tested with an engine and a fuel injection system designed to operate with diesel fuel. The engine did pass the 400-hour endurance test with the exception of the delivery valve gasket. The delivery valve gasket failed at the 388th hour of endurance testing. This failure was due to the FRDF chemical attack on the gasket's copper material.

The storage stability of the FRDF lasted for 2 weeks. The mixer did not give the intended mixing ratio. The tap water ratio in the FRDF varied between 10.2 to 13.2 percent volume.

4.0. RECOMMENDATIONS

In order to benefit from the FRDF's positive characteristics and make the negative characteristics acceptable, the FRDF research and development program should continue. Continuation of the laboratory's engine testing and initiation of field vehicle tests per planned mission profile are essential for the success of this program.

Other issues which should be addressed are:

- Storage life improvement of the FRDF,
- Design improvement of the blending system of the FRDF,
- Incorporation of a fuel heating device into the vehicle fuel system for cold-weather operation with FRDF below 0 C.

- Redesign of the engine and fuel injection system parts which failed and/or eroded because of the use of FRDF, and
- Development of a logistics support plan.

5.0. DISCUSSION

5.1. <u>Test Program</u>

The purpose of the DT-466 Navistar Diesel Engine 400-Hour Durability and Performance Test with FRDF is to determine the effects of tap water blended with diesel fuel on the performance and durability of the engine's fuel injection system (fuel pump and injectors), pistons, rings, cylinders, cylinder head and valves, and to detrmine how a rated performance and proven durability of a commercial diesel engine will change. Test location was Building 212, Cell no. 1, TACOM. See Tables 5-1 through 5-16 for detailed test equipment and test program information.

Table 5-1. Engine Specification

Engine Model: DT 466, S/M 467-TM2U176482
Rated full-load power, without fan, with air cleaner: 210 hp at 2,600 rpm
Number of Cylinders: 6-cylinder in line
Type: 4 stroke per cycle, compression - ignition, turbocharged
Bore: 4.301 in.
Stroke: 5.350 in.
Displacement: 466.4 in.
Compression ratio: 16.3:1
Dry Engine Weight: 1,400 lbs
Firing Order: 1-5-3-6-2-4
Lubricating Oil: MIL-L-21040 - Grade 15W40
Fuel Injection Pump: MW, S/N 24581842

Table 5-2. FRDF and DF2

1. Planned percentages of the FRDF are:

78% DF2 10% tap water 12% Surfactant (Emulsifier)

- 2. Due to the faulty functioning of the mixer during the mixing process, the percentages were different from those planned above. The actual test percentages of the FRDF mixture are stated in the tables of this report.
- 3. Fuel to be used for break-in, initial and final performance test is DF2.
- 4. Fuel to be used in the 400-hour durability and performance tests is FRDF.

Table 5-3. Dynamometer Specification

Made by Eaton

Model No.: 1014WIG Serial No.: 67637-1 Power Range: 250 hp

Speed Range: 1,800 to 6,000 rpm Torque Arm: 21.008 in.

DC Excitation: 220 volts - 2.6 amps 59 OHMs and 20 °C

Water Requirements: 18 GPM max. at 35 psi min. and 100 psi max.

Table 5-4. Test Cell Preparation and Tests Outline

- In cell no. 1, install DT 466 diesel engine together with cooling water tower and dynamometer. Install instrumentation, temperature and pressure thermocouples and probes. Use the existing Elwood recording data system.
- Install all required pressure lines, speed and load cells connections, fuel throttle lever, shut-off lever, aneroid assembly, exhaust and intake air connections; provide emergency fuel shutoff and warning lights. Shut down system for critical temperature, pressure and rpm limits on engine and dynamometer. Engine blow-by volume and pressure is to be recorded during full power performance. Engine's air, oil, coolant, temperature, pressure and exhaust gas temperature will be monitored and recorded.
- Test cell air depression: 1.2 in H₂0 max.

Outline of Tests

- 1. Prepare engine for performance and endurance tests, install instrumentation, calibration of instrumentation and equipment, engine operating limits, adjustment and instrumentation checkout.
- 2. Break in run with DF2 (see Table 5-10).
- 3. Test for performance, full and part loads with DF2 (Table 5-12).
- 4. Test for performance, full and part loads with FRDF (Table 5-13).
- 5. Run 400-hour NATO durability test with FRDF. Part- and full-load data are from FRDF performance data (see Table 5-13).
- 6. At the end of each 100-hour durability test, check the engine for full-load performance.
- 7. At the conclusion of the 400-hour durability run, test the engine for full- and part-load performance on FRDF and DF2.
- 8. For maintenance procedures refer to Section 2-4 of the NATO standard diesel and spark ignition engines laboratory test, Jan 84 (see Appendix A).
- At the start of each test, record the barometric pressure, temperature and relative humidity.
- At the conclusion of performance tests with DF2 fuel, test the engine with FRDF to obtain full-load performance data. Follow the same procedures followed with DF2 fuel and record full- and part-load performance using Table 5-13.

Table 5-5. Safety Shutdown Parameters

Parameter	Engine Shutdown
Coolant temperature measured at rear of cylinder head	210°F max
Engine blow - by at rated power	6 cu ft/min max
Exhaust temperature, turbine inlet	1350°F max
Exhaust temperature, turbine outlet	1150°F max
Oil gallery pressure:	
Cycle test	10 PSI min
Full load test	30 PSI min
Crankcase pressure	6" H20 max
Overspeed	3200 RPM max
Underspeed	600 <u>+</u> 25 RPM
Oil temperature	265°F max

- The restriction measured at full load and rated speed in the fuel line between the primary filter and the fuel supply pump should not exceed 6 inches of Hg.
- The engine blow-by thru the breather at rated speed and power of 2600 RPM and 210 HP is 6 CFM at 6 inches of H₂o maximum.
- The test air cleaner flow at rated engine's power speed is 1100 CFM.

Table 5-6. Temperature Ranges of the Thermocouples

Thermocouple	Range	Accuracy
	•F	
Air, cell ambient	60-120	<u>+</u> 2
Air, cleaner inlet	60-120	<u>+</u> 2
Air, cleaner outlet	60-120	<u>+3</u>
Air from Turbocharger	60-300	<u>+</u> 3
Fuel spillback after pump	60-150	<u>+</u> 3
Exh. outlet (before and after turbo)	500-1700	<u>+</u> 5
Exhaust ports	500-1700	<u>+</u> 5
Fuel (before fuel pump)	60-120	<u>+</u> 3
Fuel at secondary filter	60-150	<u>+</u> 10
Coolant, engine-outlet and inlet	120-250	<u>+</u> 3
Cooling water tower, inlet	35-100	<u>+3</u>
Cooling water tower, outlet	35-250	<u>+</u> 3
Engine oil	60-300	<u>+</u> 3
Instrumentation bath	150-250	+3

Table 5-7. Pressure Ranges of the Transducers

Pressure Range	Transducer	Data Point
-4.16 in H ₂ O	.15 PSI	Cell depression
-27.76 in H ₂ O	1.0 PSI	Air before turbo
27.76 in H ₂ O	1.0 PSI	Air cal. orifice
27.76 in H ₂ O	1.0 PSI	Air crankcase
83.30 in H ₂ O	3.0 PSI	Exhaust after turbo
61.23 in Hg	30.0 PSI	Air after turbo
61.23 in Hg	30.0 PSI	Exhaust before turbo
30.0 PSI	30.0 PSI	Fuel after engine filters
30.0 PSI	30.0 PSI	Fuel pump spillback
30.0 PSI	30.0 PSI	Fuel injectors spillback
100.0 PSI	100.0 PSI	Oil engine gallery
100.0 PSI	100.0 PSI	Coolant engine in
100.0 PSI	100.0 PSI	Coolant engine out
100.0 PSI	100.0 PSI	Cooling water tower in
300.0 PSI	300.0 PSI	Dyno water in

Table 5-8. Warning—Shutdown Temperatures

Data Point	Temp F	Warning F	Shutdown F
Air ambient in test cell Air before air cleaner Air after air cleaner Air after turbo	77 <u>+</u> 5 77 <u>+</u> 5		
Oil sump Oil Gallery Oil after turbo		255 255 255	265 265 265
Fuel before engine filters Fuel after engine filters Fuel spillback (combined) Coolant engine in	86 <u>+</u> 4	233	203
Coolant engine out Cooling water in (tower) Cooling water out (tower)	2Ø5 <u>+</u> 4	210	215
Dyno water out Reference bath		140	145
Exhaust port No. 1 Exhaust port No. 2 Exhaust port No. 3 Exhaust port No. 4 Exhaust port No. 5 Exhaust port No. 6 Exhaust before turbo - front Exhaust before turbo - rear Exhaust after turbo		1300 1300 1300 1300 1300 1300 1300 1300	1350 1350 1350 1350 1350 1350 1350 1350

Table 5-9. Warning--Shutdown Pressures

Data Point	Pressure	Warning	Shutdown
Air cell depression	`.		
Air before turbo (T)	-10 <u>+</u> 2" H ₂ O		
Air before turbo (S)			
Air calibrated orifice			
Air crankcase		4" H ₂ O	6" Н ₂ О
Exhaust after turbo (S)	16 <u>+</u> 2" н ₂ 0	20" H ₂ O	25" H ₂ O
Air after turbo (boost)			
Exhaust before turbo			
Fuel before engine filter			
Fuel spillback (inj + pump)			
Oil engine gallery		12 PS:	I 10 PSI
Coolant engine in			
Coolant engine out			
Cooling water tower in		40 PS	30 PSI
Dyno water in		10 PS	8 PSI
Fuel after engine filters			

Table 5-10. Engine Break-in Run

Torque	9	2	S	7	9	0	0	0	6	490	_	9	S	3	2	Ø	Ø	0	2	3	7
Full Load BHP	91	Ø	2	\sim	S	9	~	8	9	196	8	Ø	0	Ø	\vdash	9	~	ω	Ø	Ø	-
Engine Speed	20	30	40	50	60	70	80	90	00	2100	20	30	40	50	60	70	80	90	40	50	Ø 9
Time/Minutes	15	15	3.0	30	30	30	30	30	30	30	30	38	3.0	30	30	30	30	30	3.0	3.8	3.0
Break-in Period No.		2	ı m	7	ഹ	9	7	8	6	1.0	11	12	13	1.4	15	16	17	18	19	20	21

operation of instrumentation, recording and printout systems; maintain the temperature and pressure listed in the above During the break-in period, check engine for leaks, warning shutdown table.

Run engine break-in test with full load using DF2 fuel.

Continually monitor engine parameter versus the operating limits stated in its safety shutdown parameters. The engine's blow-by volume and pressure should not exceed 360 cu ft/hr or 6 CFM and 6 inches of water at rated engine speed and power of 2,600 rpm and 210 hp.

Shut down the engine for diagnosis and repair if the blow-by exceeds allowed maximum or if the other operating parameters' limits are exceeded. The engine break-in should be conducted as shown above.

For each break-in period, record complete data on log sheet.

Table 5-11. Initial Engine Performance Test with DF2 Fuel

For initial engine performance test use DF2 fuel. Test the engine for performance and record the data as follows:

• Full-load performance test

-The full-load (full-rack) performance test, bhp, fuel consumption, torque, bmep and bsfc data, will be recorded at a seven-speed setting, two of these settings at the rated torque speed of 1,800 rpm and the rated hp speed of 2,600 rpm.

-The seven speed settings are to start at 1,400 rpm with increments of 200 rpm for each setting.

-For each setting, the engine should be run for a sufficient time to allow the operating parameters to stabilize.

• Part-load performance test of 85%, 70%, 50% and 25% of the full load

-Using throttle control and the dynamometer, test the engine and record complete data for each of the four part-load settings of 85%, 70%, 50% and 25% of the full-load test.

-Each part-load setting is to be tested with the above established seven speed settings, starting at 1,400 rpm and ending at 2,600 rpm with 200-rpm increments.

No correction factor will be applied and the test results must include air cell temperature, atmospheric and cell pressure and humidity.

• Go to Table 5-12.

Table 5-12. Development of Part-Load Performance Data from Full-Load 100% Performance Run for DF2 Fuel

LOAD	RPM	TORQUE
100%	1400	455
	1600	493
	1800	517
	2000	496
	2200	459
	2400	447
	2600	422
85%	1400	387
	1600	419
	1800	439
	2000	422
	2200	390
	2400	380
	2600	359
70%	1400	318
	1600	345
	1800	362
	2000	347
	2200	321
	2400	313
	2600	295
50%	1400	227
	1600	246
	1800	258
	2000	248
	2200	229
	2400	223
	2600	211
25%	1400	114
	1600	123
	1800	129
	2000	124
	2200	115
	2400	112
	2600	105

Table 5-13. Development of Part-Load Performance Data from Full-Load 100% Performance Run for FRDF

• At the conclusion of performance tests with DF2 fuel, test the engine with FRDF to obtain full-load performance data. Follow the same procedures followed with DF2 and record full- and part-load performance using the following table:

LOAD	RPM	TORQUE
100%	1400	383
	1600	407
	1800	431
	2000	429
	2200	410
	2400	399
	2600	371
85%	1400	327
	1600	346
	1800	366
	2000	364
	2200	348
	2400	339
	2600	315
7Ø%	1400	268
	1600	285
	1800	301
	2000	300
	2200	287
	2400	279
	2600	259
50%	1400	191
	1600	203
	1800	215
	2000	214
	2200	205
	2400	199
	2600	195
25%	1400	96
	1600	102
	1800	108
	2000	107
	2200	102
	2400	100
	2600	93

Table 5-14. 400-Hour NATO Endurance Test with FRDF

The endurance test duration is 400 hours divided into four periods of 100 hours each. At the completion of each period, the engine shall be submitted to a full-load performance check.

Each 100-hour period is to comprise ten (10) hour cycles. Each 10-hour cycle will be carried out in accordance with the following program:

Program of 10 Hour Cycle

Subcycle	% Rated Speed	% Load	Duration in Hours			
1	IDLE 660+ 25 RPM	0	1 2			
2	100 2600 RPM	100	2			
3	2900 <u>+</u> 25 RPM (GOVERNED SPEED)	0	1/2			
4	75 1950 RPM	100	1			
5	IDLE100 660 <u>+</u> 25 2600 RPM	0100 4 MIN 6 MIN	2			
6	60 1560 RPM	100	2			
7	IDLE 660 <u>+</u> 25 RPM	0	1/2			
8	2700+ 25 RPM (GOVERNED SPEED)	70	1 2			
9	MAX TORQUE SPEED 1800 RPM	100	2			
10	60 1560 RPM	50	1 2			

NOTE: Conduct the maintenance, oil change, oil and fuel filter change and data recording; per Part II of NATO Standard Diesel and Spark Ignition Engines Laboratory Test (Revised Jan 84) Section 2-4, Page 32. (See Appendix B.)

Table 5-15. Instruments and Equipment

- Instruments to be Used in the Test Program
 - -Elwood data acquisition system to be used for data gathering.
 - -Load cell to be used for measuring torque.
- -Digital Elwood fuel weigh system to be used for measuring fuel.
 - -Cooling tower system.
 - -Engine blow-by measuring system.
 - -Oil bath temperature.
- Calibration of Instruments and Equipment
- -The instrumentation and equipment used in the test cell will be calibrated prior to the start of the test and within ranges specified in previous paragraphs of this report.
- ullet Further instructions will be given by the engineer when it is necessary during the test.
- Daily before every start up of testing, check coolant and oil levels and check for loose bolts, nuts, brackets, harnesses and cracks. Correct the problem and report it to the project engineer. Record the above in the log book in detail.
- Air-operated torque wrench should not be used on rotating engine parts.
- Provide high-visibility transparent fuel line near control room window.

- FRDF and Oil Samples
- 1. Each 50 hours of durability testing, take 8 ounces of fuel sample at the mixer for laboratory analysis at Belvoir Fuels and Lubricants Research Facility (SWRI).
- 2. Take 2 ounces of oil sample before starting endurance test and every 50 hours thereafter from oil gallery.
- 3. Check engine oil level and appearance at completion of every shift or before engine is started for a new day of tests.
- 4. Record data during the last five minutes of each of the endurance periods listed in test schedule.
- Test Conclusion
- 1. At the conclusion of the 400-hour durability test disassemble and inspect the following:
 - -Fuel injection pump
 - -Injectors
 - -Engine's rotating and reciprocating parts
- 2. Prepare report.

The end of test program.

5.2. Performance Analysis for Engine Operation with DF2 vs. FRDF

5.2.1. Horsepower (hp) Loss and Specific Fuel Consumption (SFC) Increase due to the Engine Operation with DF2 vs. FRDF with 10.4 Percent Volume Added Tap Water. (See Table 5-17.)

$$208 - 183 = 25 \text{ hp}$$

208 hp = maximum engine rated hp with DF2, and 0-hour endurance

183 hp = maximum engine rated hp with FRDF containing 10.4% added tap water, full load and at 0-hour endurance

25 hp = lost hp due to the use of FRDF

$$\frac{25 \times 100}{208}$$
 = 12% of hp decrease

$$\emptyset.484 - \emptyset.410 = \emptyset.074$$

- 0.410 <u>lb</u> hp-hr = specific fuel consumption rate with DF2, 100% engine load, rated rpm and at 0-hour endurance.
- 0.074 <u>lb</u> hp-hr = specific fuel consumption increase due to the use of FRDF

0.074 * 100 = 18% of SFC increase due to the use of FRDF with 10.4% volume added tap water.

5.2.2. Horsepower Loss and SFC Increase due to Engine Operation with DF2 vs. FRDF with 12 Percent Volume Added Tap Water (see table 5-17).

$$202 - 175 = 27 \text{ hp}$$

202 hp = maximum engine hp with DF2 and 400-hour endurance

175 hp = maximum engine hp with FRDF containing 12% volume added tap water and at 400-hour endurance

27 hp = lost hp due to the use of FRDF with 12% volume added tap water.

$$\frac{27 \times 100}{202}$$
 = 13.36% of hp decrease

$$\emptyset.513 - \emptyset.414 = \emptyset.099$$
 lb hp-hr

0.513 1b hp-hr = specific fuel consumption rate with FRDF containing 12% volume added tap water, 100% engine load, rate rpm and at 400-hour endurance

0.414 lb hp-hr = specific fuel consumption rate with DF2, 100% engine load, rated rpm, and at 400-hour endurance.

0.099 * 1000.414 = 23.91% of SFC increase due to the use of FRDF with 12% added tap water

5.2.3. Horsepower and SFC Losses using FRDF at the End of 400-Hour Endurance Test with FRDF.

$$183 - 175 = 8 \text{ hp}$$

 $\frac{8 * 100}{183}$ = 4.37 % of hp decrease tested with FRDF at the end of the 400-hour endurance test with FRDF

$$\emptyset.513 - \emptyset.484 = \emptyset.029$$
 bhp-hr

 $\frac{0.029 * 100}{0.484}$ = 5.99% \doteq 6% of SFC increase at the end of 400-hour endurance test

Table 5-17. Brake Horsepower and Brake Specific Fuel Consumption of the Engine Using DF2 and FRDF

Fuel	Engine % Load	Rated Engine rpm	Engine Endurance hrs	Added % Vol water	hp	bsfc lb hp-hr	% hp decrease	% SFC increase
DF2	100	2,600	Ø	Ø	208	.410	Ø	Ø
DF2	100	2,600	400	Ø	202	.414	2.88	1
FRDF	100	2,600	Ø	10.4	183	.484	12	18
FRDF	100	2,600	400	12	175	.513	13.36	23.91

5.3. Inspection Results

- 5.3.1. Fuel Injection System Inspection. At the conclusion of the 400-hour NATO cycle test, the fuel injection system was disassembled for visual and dimensional inspection. The visual inspection showed the following:
 - The nozzles were in good condition except for signs of heat buildup on the guide portion of the nozzle valve stem.
 - The plungers, barrels, springs and delivery valves were in good condition.
 - The delivery valve gasket (second rear) failed at 388 hours of durability testing, causing a fuel leak outside the pump. The failed valve gasket was replaced by a new one and the test continued.
 - The remaining gaskets eroded to their near outside diameter, but completed the test without fuel leak.
 - The gasket's erosion was caused by the chemical attack of the oleic acid, contained in the FRDF on the copper material gaskets.
 - The clamping forces on the failed and eroded gaskets were adequate, based on the amount of knife edge deformation on the discharge fittings.
 - The fuel lines and remaining parts of the fuel injection system were in good condition.
- 5.3.2. Nozzles Opening Pressure Inspection.
 - The design specification of the nozzle opening pressure is 3,600 to 3,750 psi and the service specification of the opening pressure is 3,000 to 3,250 psi.
 - Test nozzles' opening pressures after engine endurance tests were within the service specification limits as in Table 5-18.
- 5.3.3. Engine Inspection. At the conclusion of the 400-hour NATO cycle test, two pistons of the engine (numbers one and three) were removed from the crankcase and all valves removed from the cylinder head for visual and dimensional inspection. The visual inspection showed the following:
 - Piston pressure ring faces exhibited slight wear rate, however, they were still in satisfactory condition.
 - Pistons and valves were in good condition with no evidence of chemical erosion or corrosion.

Table 5-18. Nozzles' Opening Pressure Inspection (PSI)

Nozzle Number	Opening Pressure
1	3,280
2	3,430
3	3,400
4	3,500
5	3,320
6 ,	3,470

NOTE: These opening pressures fall within the service opening pressure range.

- The carbon deposit levels on these parts were light to moderate.
- The remaining parts were in good condition.

5.4. Oil and Filter Changes

Oil, oil filter and fuel filter changes were performed five times during the engine test. Changes were performed at the end of the break-in test and after each 100-hour durability test.

5.5. Horsepower and Torque versus rpm

- The maximum horsepower with FRDF occurred at 2,500 rpm and continued nearly constant throughout 2,600 rated engine rpm on most of the performance curves.
- The maximum rated horsepower with DF2 occurred at 2,600 rpm.
- The maximum torque with FRDF occurred at 1,940 rpm.
- The maximum rated torque with DF2 occurred at 1,800 rpm.

See the tables (5-19 through 5-85) and figures (5-1 through 5-41) contained in this report for more information on performance test data.

Table 5-19. Performance Test Data(100% Load, DF2, 9-Hour)

DT-466 NAVISTAR DIESEL ENGINE S/N 176482

100% LOAD

DIESEL FUEL (DF2)

ENDURANCE TEST HOURS: Ø

RPM	1B-FT	ВНР	1B HR	<u>lb</u> BHP-HR	BMEP
1400	455	121	45.0	Ø.371	147.2
1600	493	150	52.6	Ø.35Ø	159.0
1800	517	177	64.1	Ø.361	167.3
2000	496	188	68.1	Ø.362	160.5
2200	471	197	73.8	Ø.384	148.5
2400	442	202	79.48	Ø . 393	143.0
2600	422	208	85.3	Ø.41Ø	136.5
2888					

Table 5-20. Performance Test Data (85% Load, DF2, O-Hour)

DT-466 NAVISTAR DIESEL ENGINE S/N 176482

85% LOAD

DIESEL FUEL (DF2)

ENDURANCE TEST HOURS: Ø

RPM	lb-FT	внр	<u>1B</u> HR	<u>lb</u> BHP-HR	BMEP
1400	386	103	37.4	Ø.365	124.9
1600	419	127	44.7	Ø.349	135.5
1800	439	150	53.3	Ø.354	142.0
2000	422	160	58.1	Ø.361	136.5
2200	401	168	60.8	Ø.37Ø	126.8
2400	380	173	68.56	ø . 396	122.9
2600	439	177	73.0	Ø.412	116.1
2888					

Table 5-21. Performance Test Data (70% Load, DF2, 0-Hour)

DT-466 NAVISTAR DIESEL ENGINE S/N 176482

70% LOAD

DIESEL FUEL (DF2)

ENDURANCE TEST HOURS: Ø

RPM	1B-FT	ВНР	<u>lB</u> HR	<u>1B</u> BHP-HR	BMEP
1400	317	84	28.4	Ø.336	102.5
1600	346	105	36.2	0.344	111.9
1800	362	124	44.1	Ø.355	117.1
2000	347	132	48.1	Ø.364	112.2
2200	329	138	51.2	Ø.381	103.8
2400	313	143	56.36	Ø . 395	101.2
2600	295	145	61.8	0.423	95.4
2888					

Table 5-22. Performance Test Data (50% Load, DF2, O-Hour)

DT-466 NAVISTAR DIESEL ENGINE S/N 176482

50% LOAD

DIESEL FUEL (DF2)

ENDURANCE TEST HOURS: Ø

RPM	lb-FT	ВНР	1B HR	<u>1B</u> BHP - HR	BMEP
1400	227	60	22.3	Ø.368	73.4
1600	246	74	27.8	Ø.37Ø	79.6
1800	257	88	32.6	0.370	83.1
2000	248	94	36.4	0.385	80.2
2200	236	99	38.4	0.400	74.1
2400	223	101	42.9	0.421	72.1
2600	211	104	46.7	Ø.447	68.2
2888					

Table 5-23. Performance Test Data (25% Load, DF2, O-Hour)

DT-466 NAVISTAR DIESEL ENGINE S/N 176482

25% LOAD

DIESEL FUEL (DF2)

ENDURANCE TEST HOURS: Ø

RPM	18-FT	ВНР	1B HR	<u>lb</u> BHP-HR	BMEP
1400	113	3Ø	13.3	Ø.441	36.5
1600	123	37	16.4	Ø . 437	39.8
1800	129	44	18.0	Ø . 4Ø7	41.7
2000	124	47	21.8	Ø . 462	40.1
2200	118	49	23.3	Ø.483 -	37.2
2400	112	51	27.2	Ø . 531	36.2
2600	105	51	30.0	Ø . 577	33.9
2888					

Table 5-24. Performance Test Data (100% Load, FRDF, 0-Hour)

DT-466 NAVISTAR DIESEL ENGINE S/N 176482

100% LOAD

FIRE RESISTANT DIESEL FUEL (FRDF)

ENDURANCE TEST HOURS: Ø

TOTAL OPERATING HOURS: 43

RPM	lB~FT	внр	1B HR	<u>lb</u> BHP-HR	BMEP
1400	383	102	43.3	Ø.424	123.9
1600	407	124	52.5	Ø.422	131.7
1800	431	147	62.5	Ø .42 5	139.4
2000	429	163	69.1	Ø.422	138.8
2200	419	175	76.9	Ø.439	132.6
2400	399	182	82.1	0.450	129.1
2600	371	183	88.9	Ø.484	120.0
2888					

FRDF CONTENT:

78. VOL % DF2

11.6 VOL % SURFACTANT (EMULSIFIER)

10.4 VOL % Detroit Tap Water

Table 5-25. Performance Test Data (85% Load, FRDF, O-Hour)

DT-466 NAVISTAR DIESEL ENGINE S/N 176482

85% LOAD

FIRE RESISTANT DIESEL FUEL (FRDF)

ENDURANCE TEST HOURS: Ø

TOTAL OPERATING HOURS: 46

RPM	lb-FT	ВНР	1B HR	<u>lb</u> BHP-HR	BMEP
1400	321	85	33.6	ؕ392	103.8
1600	348	105	44.1	Ø.416	112.6
1800	363	124	52.2	Ø.42Ø	117.4
2000	365	138	55.9	Ø.434	118.1
2200	351	147	65.4	Ø.444	113.5
2400	339	154	72.0	Ø . 464	109.6
2600	317	156	77.2	Ø . 492	102.5
2895	40	22	28.2	1.011	12.9

FRDF CONTENT:

78 - VOL % DF2

11.6 VOL % SURFACTANT (EMULSIFIER)

Table 5-26. Performance Test Data (70% Load, FRDF, 0-Hour)

DT-466 NAVISTAR DIESEL ENGINE S/N 176482

70% LOAD

FIRE RESISTANT DIESEL FUEL (FRDF)

ENDURANCE TEST HOURS: Ø

TOTAL OPERATING HOURS: 49

RPM	lb-FT	ВНР	<u>1B</u> HR	<u>lb</u> BHP-HR	BMEP
1400	266	70	29.3	Ø.413	86.0
1600	287	87	35.4	Ø.427	92.8
1800	3Ø2	103	43.9	Ø.424	97.7
2000	299	113	50.3	0.441	96.7
2200	291	120	54.8	0.455	92.8
2400	279	127	60.4	0.473	90.2
2600	260	128	65.7	0.510	84.1
2895					

FRDF CONTENT:

78 VOL % DF2

11.6 VOL % SURFACTANT (EMULSIFIER)

Table 5-27. Performance Test Data (50% Load, FRDF, 0-Hour)

DT-466 NAVISTAR DIESEL ENGINE S/N 176482

50% LOAD

FIRE RESISTANT DIESEL FUEL (FRDF)

ENDURANCE TEST HOURS: Ø

TOTAL OPERATING HOURS: 52

RPM	lb-FT	ВНР	<u>1B</u> HR	<u>1B</u> BHP-HR	BMEP
1400	188	5ø	23.1	Ø . 461	60.8
1600	200	60	27.5	Ø.451	64.7
1800	215	73	33.7	Ø.457	69.5
2000	214	81	38.7	Ø.475	69.2
2200	205	85	41.4	Ø.481	66.3
2400	200	91	46.9	Ø . 513	64.7
2600	186	92	51.2	Ø.556	60.1
2895					

FRDF CONTENT:

78 VOL % DF2

11.6 VOL % SURFACTANT (EMULSIFIER)

Table 5-28. Performance Test Data (25% Load, FRDF, O-Hour)

DT-466 NAVISTAR DIESEL ENGINE S/N 176482

25% LOAD

FIRE RESISTANT DIESEL FUEL (FRDF)

ENDURANCE TEST HOURS: Ø

TOTAL OPERATING HOURS: 55

RPM	lb-FT	ВНР	<u>lB</u> HR	<u>lb</u> BHP-HR	BMEP
1400	96	25	13.5	Ø . 526	31.0
1600	101	30	15.8	Ø.514	32.6
1800	106	36	19.5	Ø.537	34.3
2000	107	40	23.6	Ø . 579	34.6
2200	103	43	26.4	Ø.611	33.3
2400	100	45	30.4	Ø . 665	32.3
2600	95	46	33.2	ø . 706	30.7
2895					

FROF CONTENT:

78 VOL % DF2

11.6 VOL % SURFACTANT (EMULSIFIER)

Table 5-29. Performance Test Data (100% Load, FRDF, 100-Hour)

DT-466 NAVISTAR DIESEL ENGINE S/N 176482 100% LOAD

PERFORMANCE TEST DATA WITH FIRE RESISTANT

DIESEL FUEL (FRDF) AFTER 100 HOURS OF ENDURANCE

TESTS WITH THE SAME FRDF

ENDURANCE TEST HOURS: 100

TOTAL OPERATING HOURS: 158

RPM	LB-FT	BHP	1B HR	LB BHP-HR	BMEP
1400	378	100	44.2	Ø.438	122.3
1600	402	122	53.1	Ø . 433	130.0
1800	431	147	63.7	Ø . 431	139.4
2000	438	166	72.7	Ø . 436	141.7
2200	419	175	78.8	Ø . 448	135.5
2400	391	178	83.9	Ø . 469	126.5
2600	365	18Ø	89.5	Ø . 495	118.1
2895					

FRDF CONTENT:

78 VOL % DF2

10.2 VOL % SURFACTANT (EMULSIFIER)

Table 5-30. Performance Test Data (100%, FRDF, 200-Hour)

DT-466 NAVISTAR DIESEL ENGINE S/N 176482 100% LOAD

PERFORMANCE TEST DATA WITH FIRE RESISTANT

DIESEL FUEL (FRDF) AFTER 200 HOURS OF ENDURANCE

TESTS WITH THE SAME FROF

ENDURANCE TEST HOURS: 200

TOTAL OPERATING HOURS: 261

RPM	LB-FT	ВНР	1B HR	<u>LB</u> BHP-HR	BMEP
1400	360	95	43.3	Ø.452	116.4
1600	382	117	51.9	Ø.446	123.6
1800	407	139	61.7	0.442	131.7
2000	415	158	70.3	0.444	134.2
2200	401	167	77.3	Ø . 46Ø	129.7
2400	382	174	83.5	Ø . 478	123.6
2600	358	177	89.1	Ø . 5Ø3	115.8
2895					

FRDF CONTENT:

78 VOL % DF2

10.2 VOL % SURFACTANT (EMULSIFIER)

Table 5-31. Performance Test Data (100% Load, FRDF, 300-Hour)

DT-466 NAVISTAR DIESEL ENGINE S/N 176482

100% LOAD

PERFORMANCE TEST DATA WITH FIRE RESISTANT

DIESEL FUEL (FRDF) AFTER 300 HOURS OF ENDURANCE

TESTS WITH THE SAME FROF

ENDURANCE TEST HOURS: 300

TOTAL OPERATING HOURS: 364

RPM	LB-FT	BHP	1B HR	<u>LB</u> BHP-HR
1400	369	98	44.7	Ø.454
1600	397	121	53.3	0.440
1800	423	144	62.9	Ø.436
2000	427	162	72.1	Ø.443
2200	412	172	78.5	Ø.455
2400	390	178	84.5	0.474
2600	356	176	89.5	Ø . 5Ø7
2895				

FRDF CONTENT:

78 VOL % DF2

10 VOL % SURFACTANT (EMULSIFIER)

Table 5-32. Performance Test Data (100% Load, FRDF, 400-Hour)

DT-466 NAVISTAR DIESEL ENGINE S/N 176482

100% LOAD

PERFORMANCE TEST DATA WITH FIRE RESISTANT

DIESEL FUEL (FRDF) AFTER 400 HOURS OF ENDURANCE

TESTS WITH THE SAME FROF

ENDURANCE TEST HOURS: 400

TOTAL OPERATING HOURS: 467

RPM	LB-FT	ВНР	1B HR	<u>LB</u> BHP-HR	BMEP
1400	376	100	44.0	Ø.438	121.6
1600	4Ø3	122	53.2	Ø . 433	130.4
1800	423	144	62.8	Ø . 433	136.8
2000	425	161	71.0	Ø.438	137.5
2200	4ø9	171	77.6	Ø . 452	132.3
2400	388	177	83.6	0.471	125.5
2600	353	175	89.9	0.513	115.8
2895					

FRDF CONTENT:

⁷⁸ VOL % DF2

¹⁰ VOL % SURFACTANT (EMULSIFIER)

¹² VOL % WATER

Table 5-33. Performance Test Data (85% Load, FRDF, 400-Hour)

DT-466 NAVISTAR DIESEL ENGINE S/N 176482

185% LOAD

PERFORMANCE TEST DATA WITH FIRE RESISTANT

DIESEL FUEL (FRDF) AFTER 400 HOURS OF ENDURANCE

TESTS WITH THE SAME FROF

ENDURANCE TEST HOURS: 400

TOTAL OPERATING HOURS: 470

RPM	LB-FT	ВНР	LB-HR	<u>LB</u> BHP-HR	BMEP
1400	327	87	37.7	Ø.432	105.8
1600	346	1ø5	45.5	0.431	111.9
18øø	365	125	54.2	Ø.433	118.1
2000	366	139	62.0	0.444	118.4
2200	349	150	67.5	Ø.45Ø	112.9
2400	339	154	74.4	Ø . 48Ø	109.6
2600	316	156	80.6	Ø . 515	102.2
2895					

FRDF CONTENT:

78 VOL % DF2

10 VOL % SURFACTANT (EMULSIFIER)

Table 5-34. Performance Test Data (70% Load, FRDF, 400-Hour)

DT-466 NAVISTAR DIESEL ENGINE S/N 176482

70.% LOAD

PERFORMANCE TEST DATA WITH FIRE RESISTANT

DIESEL FUEL (FRDF) AFTER 400 HOURS OF ENDURANCE

TESTS WITH THE SAME FROF

ENDURANCE TEST HOURS: 400

TOTAL OPERATING HOURS: 473

RPM	LB-FT	ВНР	1B HR	<u>LB</u> BHP-HR	BMEP
1400	268	71	31.9	Ø . 446	86.7
1600	285	86	38.1	Ø . 438	92.2
1800	298	102	45.6	Ø.443	97.0
2000	299	114	52.1	0.456	97.0
2200	291	122	56.8	Ø.472	92.8
2400	279	127	63.0	0.494	90.2
2600	260	128	68.8	Ø.537	84.1
2895					

FRDF CONTENT:

78 VOL % DF2

10 VOL % SURFACTANT (EMULSIFIER)

Table 5-35. Performance Test Data (50% Load, FRDF, 400-Hour)

DT-466 NAVISTAR DIESEL ENGINE S/N 176482

50% LOAD

PERFORMANCE TEST DATA WITH FIRE RESISTANT

DIESEL FUEL (FRDF) AFTER 400 HOURS OF ENDURANCE

TESTS WITH THE SAME FRDF

ENDURANCE TEST HOURS: 400

TOTAL OPERATING HOURS: 476

RPM	LB-FT	ВНР	1B HR	<u>LB</u> BHP-HR	BMEP
1400	193	51	24.3	Ø.472	62.4
1600	204	62	29.2	Ø . 469	66.0
1800	214	73	34.5	Ø .4 7Ø	69.2
2000	215	81	39.5	Ø.482	69.5
2200	210	88	43.3	Ø . 492	66.3
2400	200	91	49.3	Ø . 539	64.7
2600	185	92	53.7	ø . 586	59.8
2895					

FRDF CONTENT:

78 VOL % DF2

10 VOL % SURFACTANT (EMULSIFIER)

Table 5-36. Performance Test Data (25% Load, FRDF, 400-Hour)

DT-466 NAVISTAR DIESEL ENGINE S/N 176482

25% LOAD

PERFORMANCE TEST DATA WITH FIRE RESISTANT

DIESEL FUEL (FRDF) AFTER 400 HOURS OF ENDURANCE

TESTS WITH THE SAME FRDF

ENDURANCE TEST HOURS: 400

TOTAL OPERATING HOURS: 479

RPM	LB-FT	BHP	1 <u>B</u> HR	<u>LB</u> BHP-HR	BMEP
1400	94	25	14.7	Ø . 574	31.0
1600	102	31	18.5	Ø . 595	33.0
1800	105	36	21.7	Ø.591	34.6
2000	105	40	25.3	0.620	34.6
2200	103	43	28.3	Ø.655	33.3
2400	100	46	31.7	Ø . 689	32.0
2600	93	46	36.0	Ø.782	30.0
2895					

FRDF CONTENT:

78° VOL % DF2

10 VOL % SURFACTANT (EMULSIFIER)

Table 5-37. Performance Test Data (100% Load, DF2, 400-Hour)

DT-466 NAVISTAR DIESEL ENGINE S/N 176482 100% LOAD

PERFORMANCE TEST DATA WITH DIESEL FUEL (DF2)

AFTER 400 HOURS OF ENDURANCE TESTS WITH FRDF

ENDURANCE TEST HOURS: 400

RPM	LB-FT	ВНР	1B HR	<u>LB</u> BHP-HR	BMEP
1400	457	121	45	Ø . 369	147.8
1600	495	150	54.6	Ø . 361	160.1
1800	5Ø9	174	62.3	Ø3.58	164.7
2000	489	186	66.7	Ø . 358	158.2
່ 22ØØ	464	194	72.0	Ø.37Ø	150.1
2400	438	200	77.9	Ø . 389	141.7
2600	408	202	83.6	0.414	130.4
2895					

Table 5-38. Performance Test Data (85% Load, DF2, 400-Hour)

DT-466 NAVISTAR DIESEL ENGINE S/N 176482 85% LOAD

PERFORMANCE TEST DATA WITH DIESEL FUEL (DF2)

AFTER 400 HOURS OF ENDURANCE TESTS WITH FRDF

ENDURANCE TEST HOURS: 400

RPM	LB-FT	ВНР	1B HR	<u>LB</u> BHP-HR	BMEP
1400	387	103	37 . Ø	ؕ359	125.5
1600	417	127	45.7	Ø.358	135.5
1800	438	150	53.6	Ø.356	142.0
2000	420	160	58.1	Ø.361	136.5
2200	399	167	61.5	Ø.376	126.2
2400	379	173	68.6	ؕ395	122.9
2600	358	177	73.9	Ø .4 15	116.1
2895	36	19	25.8	1.302	11.6

Table 5-39. Performance Test Data (70% Load, DF2, 400-Hour)

DT-466 NAVISTAR DIESEL ENGINE S/N 176482 70% LOAD

PERFORMANCE TEST DATA WITH DIESEL FUEL (DF2)

AFTER 400 HOURS OF ENDURANCE TESTS WITH FRDF

ENDURANCE TEST HOURS: 400

RPM	LB-FT	BHP	1B HR	<u>LB</u> BHP-HR	BMEP
1400	318	84	30.4	Ø . 358	102.9
1600	345	105	37.2	Ø . 353	111.6
1800	360	123	44.5	Ø . 36Ø	116.4
2000	347	132	48.4	Ø . 366	112.2
2200	331	139	51.9	Ø . 374	103.8
2400	313	142	58.Ø	Ø.4Ø2	101.2
26ØØ	296	146	62.6	Ø .4 27	95.7
2895					

Table 5-40. Performance Test Data (50% Load, DF2, 400-Hour)

DT-466 NAVISTAR DIESEL ENGINE S/N 176482 50% LOAD

PERFORMANCE TEST DATA WITH DIESEL FUEL (DF2)

AFTER 400 HOURS OF ENDURANCE TESTS WITH FRDF

ENDURANCE TEST HOURS: 400

RPM	LB-FT	ВНР	1B HR	<u>LB</u> BHP-HR	BMEP
1400	226	60	22.1	Ø.368	73.1
1600	246	75	28.0	Ø . 373	79.6
1800	258	88	32.8	Ø.371	83.4
2000	247	94	36.1	Ø.383	79.9
2200	237	99	39.0	0.394	73.7
2400	222	101	43.6	0.429	71.8
2600	211	104	48.2	0.461	68.2
2895					

Table 5-41. Performance Test Data (25% Load, DF2, 400-Hour)

DT-466 NAVISTAR DIESEL ENGINE S/N 176482 25% LOAD

PERFORMANCE TEST DATA WITH DIESEL FUEL (DF2)

AFTER 400 HOURS OF ENDURANCE TESTS WITH FRDF

ENDURANCE TEST HOURS: 400

RPM	LB-FT	BHP	1B HR	<u>LB</u> BHP-HR	BMEP
1400	113	3Ø	13.2	Ø.438	36.5
1600	124	37	16.5	Ø.436	40.1
1800	128	4.3	19.39	Ø.451	41.4
2000	124	47	22.2	Ø . 47Ø	40.1
2200	117	49	24.3	Ø.496	37.2
2400	112	51	28.15	Ø . 552	36.2
2600	105	52	31.2	Ø.611	33.9
2895					

Table 5-42. Performance Test Data (100% Load, FRDF, 400-Hour)

DT-466 NAVISTAR DIESEL ENGINE S/N 176482

100% LOAD

PERFORMANCE TEST DATA WITH LOWER WATER PERCENTAGE

IN FRDF

ENDURANCE TEST HOURS: 400

TOTAL OPERATING HOURS: 497

RPM	LB-FT	ВНР	1B HR	<u>LB</u> BHP-HR	BMEP
1400	4Ø8	108	44.3	.407	
1600	437	133	54.0	.405	
1800	463	158	63.9	.402	
2000	453	172	70.6	.409	
2200	432	180	76.3	.421	
2400	411	187	83.3	.443	
2600	382	189	87.6	•463	
2888	37	20	28	1.415	

FRDF CONTENT:

78 VOL % DF2

11.8 VOL % SURFACTANT (EMULSIFIER)

Table 5-43. Performance Test Data (50% Load, FRDF, 400-Hour)

DT-466 NAVISTAR DIESEL ENGINE S/N 176482

50% LOAD

PERFORMANCE TEST DATA WITH LOWER WATER PERCENTAGE

IN FRDF

ENDURANCE TEST HOURS: 400

TOTAL OPERATING HOURS: 500

RPM	LB-FT	ВНР	1B HR	<u>LB</u> BHP-HR
1400	191	50	23.2	•455
1600	204	62	28.1	•452
1800	212	73	33.2	.450
2000	213	81	37.1	.458
2200	2Ø9	88	41.5	.483
2400	200	91	46.4	.507
2600	185	92	50.6	•552
2888				

FRDF CONTENT:

78 VOL % DF2

11.8 VOL % SURFACTANT (EMULSIFIER)

Table 5-44. Performance Test Data (Lubricating Oil Consumption)

DT-466 NAVISTAR DIESEL ENGINE

ENGINE LUBRICATING OIL CONSUMPTION RATE DURING 400 HOUR ENDURANCE TEST WITH FIRE RESISTANT DIESEL FUEL (FRDF)

DATE	ENDURANCE TEST, HOURS	QUANTITY ADDED, LBS	CUMULATIVE OIL CONSUMPTION, LBS	OIL CONSUMPTION RATE, LB/HR
8 -1 <u>1</u> -86	0	0	0	0
, , , , , , , , , , , , , , , , , , , ,	30	2.00	2.00	Ø.Ø66
	50	2.25	4.25	Ø.Ø85
	70	1.50	5.75	Ø.Ø82
9-17-86	100	2.25	8.00	Ø.Ø8Ø
	150	3.50	11.50	0.076
	180	1.50	13.00	0.072
	190	2.00	15.00	0.079
9-29-86	200	2.25	17.25	Ø.Ø86
	220	2.50	19.75	Ø.Ø89
	230	2.50	22.25	0.096
	250	2.50	24.75	Ø.Ø99
	260	1.25	26.00	0.100
	280	2.25	28.25	0.101
10-11-86	300	2.25	30.50	0.1016
	340	Ø.5Ø	31.00	0.091
	360	1.00	32.00	0.088
	37Ø	1.25	33.25	0.089
	38Ø	1.75	35.00	Ø.Ø921
	397	1.50	36.50	0.0919
11-4-86	400	2.00	38.50	Ø.Ø962

Table 5-45. Performance Test Data (at the end of 10-Hour)
DT-466 Navistar Diesel Engine, S/N 176482

Program of 10-Hour Endurance Test with Fire Resistant Diesel Fuel (FRDF)

Performance Data were Printed-out at the End of 10-Hour Endurance Test

Endurance Test Hours 10

Total Operating Hours 65

% LOAD	% RPM	LB-FT	ВНР	LB/HR	LB/BHP-HR	BMEP
Ø	26 IDLE	5.5		3.1		1.2
100	100 2600 RATED	372	184	90.6	Ø.491	120.3
Ø	110	39	21	30.3	1.412	12.6
100	75	421	156	67.8	Ø.433	136.2
100	60	391	116	50.1	Ø.431	126.5
70	105	265	138	73.0	Ø.528	85.7
100	69 MAX T. SPD	422	144	61.9	Ø.428	136.5
50	6 Ø	185	54	26.1	Ø.475	59.8

FRDF CONTENT:

78 VOL% DF2

11.6 VOL% SURFACTANT (EMULSIFIER)

Table 5-46. Performance Test Data (at the end of 20-Hour)

DT-466 Navistar Diesel Engine, S/N 176482

Program of 10-Hour Endurance Test with Fire Resistant Diesel Fuel (FRDF)

Performance Data were Printed-out at the End of 20-Hour Endurance Test

Endurance Test Hours 20

Total Operating Hours 75

욯	LOAD	% RPM	LB-FT	ВНР	LB/HR	LB/BHP-HR	BMEP
	Ø	26 IDLE	5		3.1		1.6
	100	100 2600 RATED	372	184	90.1	0.488	120.6
	Ø	110	35	19	30.3	1.572	11.3
	100	75	431	159	68.6	0.428	139.4
	100	60	397	117	51.1	Ø.433	128.4
	70	105	263	136	75.7	Ø . 562	85.1
	100	69	422	144	61.7	Ø.426	136.5
	5Ø	60	185	54	26.4	0.480	59.8

FRDF CONTENT:

78 VOL% DF2

11.6 VOL% SURFACTANT (EMULSIFIER)

Table 5-47. Performance Test Data (at the end of 30-Hour)

DT-466 Navistar Diesel Engine, S/N 176482

Program of 10-Hour Endurance Test with Fire Resistant Diesel Fuel (FRDF)

Performance Data were Printed-out at the End of 30-Hour Endurance Test

Endurance Test Hours 30

and the second of the second o

Total Operating Hours 85

% LOAD	% RPM	LB-FT	BHP	LB/HR	LB/BHP-HR	BMEP
Ø	26 IDLE	4.5		3.4		1.1
100	100 2600 RATED	365	180	91.0	Ø . 5Ø2	118.1
Ø	110	35	19	30.5	1.583	11.3
100	75	423	156	68.1	Ø.434	136.8
100	60	397	117	50.8	0.430	128.4
70	105	251	130	70.7	0.540	81.2
100	69	434	148	63.5	Ø.426	140.4
5Ø	60	188	55	25.9	Ø.464	60.8

FRDF CONTENT:

78 VOL% DF2

10.4 VOL% SURFACTANT (EMULSIFIER)

11.6 VOL% WATER

Table 5-48. Performance Test Data (at the end of 40-Hour)
DT-466 Navistar Diesel Engine, S/N 176482

Program of 10-Hour Endurance Test with Fire Resistant Diesel Fuel (FRDF)

Performance Data were Printed-out at the End of 40-Hour Endurance Test

Endurance Test Hours 40

Total Operating Hours 95

% LOAD	% RPM	LB-FT	ВНР	LB/HR	LB/BHP-HR	BMEP
Ø	26 IDLE	. 3		3.9		Ø.9
100	100 2600 RATED	371	183	90.6	Ø.492	120.0
Ø	110	36	19	30.3	1.531	11.6
100	75	426	158	68.25	0.432	137.8
100	60	397	117	50.3	0.426	128.4
70	105	260	135	72.0	Ø.531	84.1
100	69	420	143	61.6	0.428	135.9
50	60	188	55	23.65	0.430	60.8

FRDF CONTENT:

- 78 VOL% DF2
- 11.6 VOL% SURFACTANT (EMULSIFIER)
- 10.4 VOL% WATER

Table 5-49. Performance Test Data (at the end of 50-Hour)

DT-466 Navistar Diesel Engine, S/N 176482

Program of 10-Hour Endurance Test with Fire Resistant Diesel Fuel (FRDF)

Performance Data were Printed-out at the End of 50-Hour Endurance Test

Endurance Test Hours 50

Total Operating Hours 105

% LOAD	% RPM	LB-FT	ВНР	LB/HR	LB/BHP-HR	BMEP
Ø	26 IDLE	7		3.4		2.2
100	100 2600 RATED	373	184	90.3	Ø .4 9Ø	120.7
Ø	110	39	21	30.1	1.433	12.6
100	75	438	162	70.0	0.430	141.7
100	. 60	398	118	5Ø . 9	0.430	128.7
70	105	264	137	71.9	Ø.522	85.4
100	69	409	140	60.5	Ø.431	132.3
50	60	184	55	25.6	Ø.47	59.8

FRDF CONTENT:

78 VOL% DF2

11.6 VOL% SURFACTANT (EMULSIFIER)

Table 5-50. Performance Test Data (at the end of 60-Hour)

DT-466 Navistar Diesel Engine, S/N 176482

Program of 10-Hour Endurance Test with Fire Resistant Diesel Fuel (FRDF)

Performance Data were Printed-out at the End of 60 Hour Endurance Test

Endurance Test Hours 60

Total Operating Hours 115

% LOAD	% RPM	LB-FT	BHP	LB/HR	LB/BHP-HR	BMEP
Ø	26 IDLE	8		3.7		2.5
100	100 2600 RATED	343	169	84.0	0.494	110.9
Ø	110	36	19	30.4	1.535	11.6
100	75	315	116	52.3	0.447	101.9
100	60	4Ø3	119	51.3	0.428	130.4
70	105	271	140	74.1	0.526	87.6
100	69	436	149	63.8	0.427	141.0
5Ø	60	183	5.3	25.5	0.43	60.1

FRDF CONTENT:

⁷⁸ VOL% DF2

^{8.8} VOL% SURFACTANT (EMULSIFIER)

^{13.2} VOL% WATER

Table 5-51. Performance Test Data (at the end of 70-Hour)

Program of 10-Hour Endurance Test with Fire Resistant Diesel Fuel (FRDF)

Performance Data were Printed-out at the End of 70 Hour Endurance Test

Endurance Test Hours 70

Total Operating Hours 125

% LOAD	% RPM	LB-FT	внр	LB/HR	LB/BHP-HR	BMEP
Ø	26 IDLE	3		3.1		Ø . 9
100	100 2600 RATED	368	182	90.2	0.495	119.0
Ø	110	35	19	30.5	1.583	11.3
100	75	441	163	70.6	Ø.431	142.7
100	60	410	121	52.1	Ø.428	132.6
7Ø	105	252	131	73.5	Ø.56Ø	81.5
100	69	452	154	65.7	0.424	146.2
5Ø	60	188	55	26.5	Ø.475	60.8

FRDF CONTENT:

78 VOL% DF2

11.4 VOL% SURFACTANT (EMULSIFIER)

10.6 VOL% WATER

Table 5-52. Performance Test Data (at the end of 80-Hour)

Program of 10-Hour Endurance Test with Fire Resistant Diesel Fuel (FRDF)

Performance Data were Printed-out at the End of 80-Hour Endurance Test

Endurance Test Hours 80

Total Operating Hours 135

% LOAD	% RPM	LB-FT	ВНР	LB/HR	LB/BHP-HR	BMEP
Ø	26 IDLE			3.1		
100	100 2600 RATED	368	182	89.8	Ø.492	119.0
Ø	110	35	19	30.6	1.589	11.3
100	75	435	161	69.8	Ø.432	140.7
100	60	394	116	50.2	Ø.429	127.4
70	105	261	135	71.28	Ø.528	84.4
100	69	429	146	63.7	Ø.433	138.8
5Ø	60	186	54	26.2	0.478	60.1

FRDF CONTENT:

78 VOL% DF2

11.4 VOL% SURFACTANT (EMULSIFIER)

10.6 VOL% WATER

Table 5-53. Performance Test Data (at the end of 90-Hour)

Program of 10-Hour Endurance Test with Fire Resistant Diesel Fuel (FRDF)

Performance Data were Printed-out at the End of 90-Hour Endurance Test

Endurance Test Hours 90

Total Operating Hours 145

% LOAD	% RPM	LB-FT	BHP	LB/HR	LB/BHP-HR	BMEP
Ø	26 IDLE	5		3.4		1.6
100	100 2600 RATED	366	181	90.3	Ø.498	118.4
Ø	110	37	20	30.8	1.513	11.9
100	75	438	162	70.1	Ø.431	141.7
100	60	398	118	50.6	Ø.428	128.7
7Ø	105	269	140	71.3	Ø . 5Ø9	87.0
100	69	428	146	63.1	0.430	138.4
5Ø	60	185	54	25.6	Ø.465	59.8

FRDF CONTENT:

78 VOL% DF2

10.7 VOL% SURFACTANT (EMULSIFIER)

11.3 VOL% WATER

Table 5-54. Performance Test Data (at the end of 100-Hour)

Program of 10-Hour Endurance Test with Fire Resistant Diesel Fuel (FRDF)

Performance Data were Printed-out at the End of 100 Hour Endurance Test

Endurance Test Hours 100

Total Operating Hours 158

% LOAD	% RPM	LB-FT	ВНР	LB/HR	LB/BHP-HR	BMEP
Ø	26 IDLE	1		3.7		Ø.3
100	100 2600 RATED	363	179	90.3	0.502	117.4
Ø	110	35	19	31.0	1.631	11.3
100	75	438	162	70.4	0.432	141.7
100	60	396	117	50.9	0.433	128.1
7Ø	105	273	141	75.1	0.530	88.3
100	69	437	149	64.4	0.430	141.4
50	60	187	55	26.3	0.475	60.5

FRDF CONTENT:

78 VOL% DF2

10.2 VOL% SURFACTANT (EMULSIFIER)

11.8 VOL% WATER

Table 5-55. Performance Test Data (at the end of 110-Hour)

Program of 10-Hour Endurance Test with Fire Resistant Diesel Fuel (FRDF)

Performance Data were Printed-out at the End of 110-Hour Endurance Test

Endurance Test Hours 110

Total Operating Hours 168

% LOAD	% RPM	LB-FT	ВНР	LB/HR	LB/BHP-HR	BMEP
Ø	26 IDLE	5 ,		3.7		1.6
100	100 2600 RATED	362	179	89.6	Ø.499	117.1
Ø	110	38	20	31.2	1.494	12.2
100	75	423	157	69.1	0.439	136.8
100	60	391	116	50.7	0.436	126.5
70	105	266	137	72.2	Ø.523	86.0
100	69	424	145	63.3	Ø.435	137.2
5Ø	60	186	55	26.1	0.472	60.1

- 78 VOL% DF2
- 10.2 VOL% SURFACTANT (EMULSIFIER)
- 11.8 VOL% WATER

Table 5-56. Performance Test Data (at the end of 120-Hour)

Program of 10-Hour Endurance Test with Fire Resistant Diesel Fuel (FRDF)

Performance Data were Printed-out at the End of 120-Hour Endurance Test

Endurance Test Hours 120

Total Operating Hours 178

% LOAD	% RPM	LB-FT	ВНР	LB/HR	LB/BHP-HR	BMEP
Ø	26 IDLE	5		3.7		1.6
100	100 2600 RATED	361	178	88.46	Ø.497	116.8
Ø	110	36	19	29.5	1.553	11.6
100	75	431	159	69.3	0.433	139.4
100	60	390	115	50.7	0.437	126.2
70	105	266	137	73.9	0.537	86.0
100	69	426	145	63.2	0.433	137.8
50	60	185	54	26.0	0.473	59.8

- 78 VOL% DF2
- 10 VOL% SURFACTANT (EMULSIFIER)
- 12 VOL% WATER

Table 5-57. Performance Test Data (at the end of 130-Hour)

Program of 10-Hour Endurance Test with Fire Resistant Diesel Fuel (FRDF)

Performance Data were Printed-out at the End of 130-Hour Endurance Test

Endurance Test Hours 130

Total Operating Hours 188

% LOAD	% RPM	LB-FT	ВНР	LB/HR	LB/BHP-HR	BMEP
ø	26 IDLE	7		3.5		2.2
100	100 2600 RATED	363	179	87.1	Ø.485	117.4
Ø	110	39	21	30.3	1.415	12.6
100	75	420	155	67.9	Ø.436	135.9
100	6 Ø	393	116	50.8	Ø.435	127.1
7 Ø	105	251	130	72.5	Ø.555	81.2
100	69	429	147	63.6	Ø.432	138.8
5Ø	60	185	54	26.3	Ø.479	59.8

- 78 VOL% DF2
- 10 VOL% SURFACTANT (EMULSIFIER)
- 12 VOL% WATER

Table 5-58. Performance Test Data (at the end of 140-Hour)

Program of 10-hours Endurance Test with Fire Resistant Diesel Fuel (FRDF)

Performance Data were Printed-out at the End of 140-Hour Endurance Test

Endurance Test Hours 140

Total Operating Hours 198

용	LOAD	% RPM	LB-FT	BHP	LB/HR	LB/BHP-HR	BMEP
	Ø	26 IDLE	7	-	3.5	_	2.2
	100	100 2600 RATED	363	179	87.4	Ø.486	117.4
	Ø	110	36	19	29.7	1.564	11.6
	100	75	427	158	70.1	Ø.442	138.1
	100	6Ø	382	113	50.0	Ø . 440	123.6
	7Ø	105	269	139	74.4	Ø . 532	87.0
	100	69	424	145	63.6	Ø .4 37	137.2
	5Ø	60	183	54	26.0	Ø.478	59.2

FRDF CONTENT:

78 VOL% DF2

10 VOL% SURFACTANT (EMULSIFIER)

Table 5-59. Performance Test Data (at the end of 150-Hour)

Program of 10-hours Endurance Test with Fire Resistant Diesel Fuel (FRDF)

Performance Data were Printed-out at the End of 150-Hour Endurance Test

Endurance Test Hours 150

Total Operating Hours 208

% LOAD	% RPM	LB-FT	BHP	LB/HR	LB/BHP-HR	BMEP
Ø	26 IDLE	5	****	3.7		1.6
100	100 2600 RATED	359	177	89.4	Ø . 5Ø3	116.1
Ø	110	29	15	29.5	1.844	9.3
100	75	424	157	69.2	Ø.439	137.2
100	60	388	115	50.6	Ø.438	125.5
7Ø	105	259	134	75.5	Ø.561	83.8
100	69	420	144	63.3	Ø.44Ø	136.0
5Ø	6Ø	179	53	25.9	Ø.487	57.9

FRDF CONTENT:

78 VOL% DF2

10 VOL% SURFACTANT (EMULSIFIER)

. 12 VOL% WATER

Table 5-60. Performance Test Data (at the end of 160-Hour)

Program of 10-hours Endurance Test with Fire Resistant Diesel Fuel (FRDF)

Performance Data were Printed-out at the End of 160-Hour Endurance Test

Endurance Test Hours 160

Total Operating Hours 218

કૃ	LOAD	ફ	RPM	LB-FT	BHP	LB/HR	LB/BHP-H	R BMEP
	Ø	26 IDLE		4		3.9	~	1.2
:	100	100 2600 RATED		357	176	89.5	Ø.5Ø6	115.5
	Ø		11ø	40	22	32.0	1.450	12.9
:	100		75	419	155	68.6	0.440	135.5
	100		6ø	387	114	50.9	Ø.443	125.2
	7Ø		105	260	134	75.3	Ø . 557	84.1
	100		69	423	144	63.7	Ø.439	136.8
	5Ø		6Ø	187	55	26.4	Ø.48Ø	60.5

FROF CONTENT:

78 VOL% DF2

10 VOL% SURFACTANT (EMULSIFIER)

Table 5-61. Performance Test Data (at the end of 170-Hour)

Program of 10-hours Endurance Test with Fire Resistant Diesel Fuel (FRDF)

Performance Data were Printed-out at the End of 170-Hour Endurance Test

Endurance Test Hours 170

Total Operating Hours 228

ે	LOAD	9	RPM	LB-FT	BHP	LB/HF	R LB/BHP-H	IR BMEP
	Ø		26 IDLE	4	. —	3.9		1.2
	100		100 RATED	357	176	89.9	Ø . 5Ø8	115.5
	Ø		11ø	38	20	32.2	1.538	12.2
	løø		75	427	158	70.3	Ø.443	138.1
	100		6Ø	382	113	50.3	Ø.443	123.6
	7Ø		1ø5	267	139	74.1	Ø . 532	86.4
	100		69	415	141	63.3	Ø.445	134.2
	5Ø		6Ø	185	54	26.8	Ø.487	59.8

FRDF CONTENT:

78 VOL% DF2

10 VOL% SURFACTANT (EMULSIFIER)

Table 5-62. Performance Test Data (at the end of 180-Hour)

Program of 10-hours Endurance Test with Fire Resistant Diesel Fuel (FRDF)

Performance Data were Printed-out at the End of 180-Hour Endurance Test

Endurance Test Hours 180

Total Operating Hours 238

8	LOAD	8	RPM	LB-FT	BHP	LB/HR	LB/BHP-H	r BMEP
	Ø		26 IDLE	5		3.6		1.6
	100	100 2600 RATED		356	176	89.7	Ø . 5Ø9	115.2
	Ø		11ø	35	19	31.4	1.625	11.5
	100		75	425	157	70.2	Ø.445	137.5
	100		60	386	114	50.5	Ø.44Ø	124.9
	7Ø		1Ø5	262	135	74.4	0.547	84.7
	100		69	421	144	63.5	0.440	136.2
	5Ø		60	186	55	26.5	Ø.474	60.1

FRDF CONTENT:

78 VOL% DF2

10 VOL% SURFACTANT (EMULSIFIER)

Table 5-63. Performance Test Data (at the end of 190-Hour)

Program of 10-hours Endurance Test with Fire Resistant Diesel Fuel (FRDF)

Performance Data were Printed-out at the End of 190-Hour Endurance Test

Endurance Test Hours 190

Total Operating Hours 248

8	LOAD	% RPM	LB-FT	BHP	LB/HR	LB/BHP-HR	BMEP
	Ø	26 IDLE	4		3.7	_	1.2
	100	100 2600 RATED	356	176	89.6	Ø . 5Ø8	115.2
	Ø	110	36	19	31.7	1.599	11.6
	100	75	428	158	70.2	0.441	138.4
	100	6Ø	384	113	50.6	0.443	124.2
	7Ø	1Ø5	248	128	74.1	Ø _• 575	80.2
	100	69	421	144	63.5	Ø.439	136.2
	5Ø	6Ø	183	54	26.8	Ø.493	59.2

FRDF CONTENT:

78 VOL% DF2

10 VOL% SURFACTANT (EMULSIFIER)

Table 5-64. Performance Test Data (at the end of 200-Hour)

Program of 10-hours Endurance Test with Fire Resistant Diesel Fuel (FRDF)

Performance Data were Printed-out at the End of 200-Hour Endurance Test

Endurance Test Hours 200

Total Operating Hours 261

용	LOAD	ક્ર	RPM	LB-FT	BHP	LB/HR	LB/BHP-H	R BMEP
	Ø		26 IDLE	3		3.4		Ø . 9
	100	2600	100 RATED	357	176	89.6	Ø.5Ø6	115.5
	Ø.		110	4Ø	21	30.8	1.469	12.9
	100		75	415	154	68.2	Ø . 442	134.2
	100		60	379	112	49.6	Ø .4 4Ø	122.6
	7Ø		105	260	135	74.5	Ø . 551	84.1
	100		69	407	139	62.6	Ø .44 7	131.7
	5Ø		60	184	54	26.9	Ø.491	59.5

FRDF CONTENT:

78 VOL% DF2

10 VOL% SURFACTANT (EMULSIFIER)

Table 5-65. Performance Test Data (at the end of 210-Hour)

Program of 10-hours Endurance Test with Fire Resistant Diesel Fuel (FRDF)

Performance Data were Printed-out at the End of 210-Hour Endurance Test

Endurance Test Hours 210

Total Operating Hours 271

કૃ	LOAD	%	RPM	LB-FT	BHP	LB/H	R LB/BHP-H	IR BMEP
	Ø		26 IDLE			3.0	-	
	100		løø RATED	354	175	89.6	Ø . 511	114.5
	Ø		llø	33	18	31.3	1.724	10.6
	100		75	423	156	69.4	Ø.442	136.8
	100		6Ø	387	114	50.9	0.443	125.2
	7Ø		1ø5	259	134	74.3	Ø . 551	83.8
	løø		69	427	146	64.4	Ø.44Ø	138.1
	5Ø		60	185	54	27.1	Ø.492	59.8

FRDF CONTENT:

78 VOL% DF2

10 VOL% SURFACTANT (EMULSIFIER)

Table 5-66. Performance Test Data (at the end of 220-Hour)

Program of 10-hours Endurance Test with Fire Resistant Diesel Fuel (FRDF)

Performance Data were Printed-out at the End of 220-Hour Endurance Test $\,$

Endurance Test Hours 220

Total Operating Hours 281

윻	LOAD	% RPM	LB-FT	BHP	LB/HR	LB/BHP-HR	BMEP
	Ø	26 IDLE			3.1		
	100	100 2600 RATED	356	176	89.8	Ø . 5Ø9	115.2
	. Ø	110	34	18	32.1	1.711	11.0
	100	75	427	158	70.0	Ø.441	138.1
	100	6 Ø	391	116	51.3	Ø.441	126.5
	7Ø	1ø5	259	134	74.5	Ø.552	83.8
	100	69	423	144	66.9	Ø.441	136.8
	5Ø	6Ø	186	55	27.1	Ø.493	60.1

FRDF CONTENT:

78 VOL% DF2

10 VOL% SURFACTANT (EMULSIFIER)

Table 5-67. Performance Test Data (at the end of 230-Hour)

Program of 10-hours Endurance Test with Fire Resistant Diesel Fuel (FRDF)

Performance Data were Printed-out at the End of 230-Hour Endurance Test

Endurance Test Hours 230

Total Operating Hours 291

% LO	AD % RPM	LB-FT	BHP	LB/HR	LB/BHP-H	R BMEP
Ø	26 IDLE			3.8	_	****
100	100 2600 RATE	356 D	176	89.8	Ø . 5Ø9	115.2
Ø	110	39	21	32.3	1.503	12.6
100	75	429	159	69.9	Ø . 439	138.8
100	6Ø	399	118	51.6	Ø . 435	129.1
7Ø	105	261	135	74.7	Ø . 551	84.4
100	69	434	148	64.7	Ø.434	140.4
5Ø	60	189	56	27.5	Ø.489	61.1

FRDF CONTENT:

78 VOL% DF2

10 VOL% SURFACTANT (EMULSIFIER)

Table 5-68. Performance Test Data (at the end of 240-Hour)

Program of 10-hours Endurance Test with Fire Resistant Diesel Fuel (FRDF)

Performance Data were Printed-out at the End of 240-Hour Endurance Test

Endurance Test Hours 240

Total Operating Hours 301

કૃ	LOAD	% RPM	LB-FT	BHP	LB/HR	LB/BHP-HR	BMEP
	Ø	26 IDLE		****	3.4		
	100	100 2600 RATED	359	177	89.3	Ø . 5Ø2	116.1
	Ø	110	37	2Ø	31.8	1.562	11.9
	100	75	426	158	69.2	Ø . 437	137.8
	100	6Ø	393	116	51.Ø	Ø . 436	127.1
-	7Ø	105	261	135	74.4	Ø . 549	84.4
	100	69	433	148	64.5	Ø.434	140.1
	5Ø	60	184	54	26.7	Ø.488	59.5

FRDF CONTENT:

78 VOL% DF2

10 VOL% SURFACTANT (EMULSIFIER)

Table 5-69. Performance Test Data (at the end of 250-Hour)

Program of 10-hours Endurance Test with Fire Resistant Diesel Fuel (FRDF)

Performance Data were Printed-out at the End of 250-Hour Endurance Test

Endurance Test Hours 250

Total Operating Hours 311

용]	LOAD	એ	RPM	LB-FT	BHP	LB/HF	R LB/BHP-H	R BMEP
	Ø		26 IDLE					
10	ØØ		løø RATED	359	177	89.3	Ø . 5Ø2	116.1
	Ø	•	110	38	2Ø	32.1	1.534	12.2
1	ØØ		75	429	159	69.6	Ø.437	138.8
10	ØØ		60	401	119	51.7	Ø.433	129.7
•	7Ø	:	105	250	130	71.4	Ø . 548	80.8
10	ØØ		69	435	149	64.6	Ø . 433	140.7
!	5Ø		6Ø	186	55	26.8	Ø.484	60.1

FRDF CONTENT:

78 VOL% DF2

10 VOL% SURFACTANT (EMULSIFIER)

Table 5-70. Performance Test Data (at the end of 260-Hour)

Program of 10-hours Endurance Test with Fire Resistant Diesel Fuel (FRDF)

Performance Data were Printed-out at the End of 260-Hour Endurance Test

Endurance Test Hours 260

Total Operating Hours 321

ક્ર	LOAD	% RPM	LB-FT	BHP	LB/HR	LB/BHP-HR	BMEP
	Ø	26 IDLE				-	
	100	100 2600 RATED	352	174	89.5	Ø . 513	113.9
	Ø	110	37	20	31.8	1.567	11.9
	100	7 5	4Ø8	151	68.2	Ø.449	132.0
	100	6ø	387	115	50.4	Ø.438	125.2
	7Ø	1ø5	260	134	72.4	Ø.539	84.1
	100	69	4Ø8	139	61.9	Ø . 442	132.0
	5ø	60	172	51	25.8	Ø . 5Ø5	55.6

FRDF CONTENT:

78 VOL% DF2

10 VOL% SURFACTANT (EMULSIFIER)

Table 5-71. Performance Test Data (at the end of 270-Hour)

Program of 10-hours Endurance Test with Fire Resistant Diesel Fuel (FRDF)

Performance Data were Printed-out at the End of 270-Hour Endurance Test

Endurance Test Hours 270

Total Operating Hours 331

ક	LOAD	% RPM	LB-FT	BHP	LB/HR	LB/BHP-HR	BMEP
	Ø	26 IDLE					end use
	100	100 2600 RATED	355	175	89.0	Ø . 5Ø6	114.8
	Ø	110	38	21	30.4	1.447	12.0
	100	75	421	156	68.8	Ø.439	136.2
	1øø	6Ø	393	116	50.3	Ø.433	127.1
	7Ø	105	261,	135	73.6	Ø . 544	84.4
	1ØØ	69	428	146	63.6	Ø.433	138.4
	5Ø	6Ø	185	54	26.6	Ø.484	59.8

FRDF CONTENT:

78 VOL% DF2

10 VOL% SURFACTANT (EMULSIFIER)

Table 5-72. Performance Test Data(at the end of 280-Hour)

Program of 10-hours Endurance Test with Fire Resistant Diesel Fuel (FRDF)

Performance Data were Printed-out at the End of $280\mbox{-Hour}$ Endurance Test

Endurance Test Hours 280

Total Operating Hours 341

કૃ	LOAD	% RPM	LB-FT	BHP	LB/HR	LB/BHP-HR	BMEP
	Ø	26 IDLE			_		
	100	100 2600 RATED	358	177	89.0	Ø . 5Ø2	115.8
	Ø	110	37	2Ø	31.3	1.560	11.9
	100	75	416	154	68.1	0.441	134.6
	100	6Ø	393	116	51.1	Ø.437	127.1
	7Ø	105	257	132	74.3	Ø . 559	83.1
	100	69	421	144	63.3	Ø.438	136.2
	5Ø	60	185	54	27.0	Ø . 745	59.8

FRDF CONTENT:

78 VOL% DF2

10 VOL% SURFACTANT (EMULSIFIER)

Table 5-73. Performance Test Data (at the end of 290-Hour)

Program of 10-hours Endurance Test with Fire Resistant Diesel Fuel (FRDF)

Performance Data were Printed-out at the End of 290-Hour Endurance Test

Endurance Test Hours 290

Total Operating Hours 351

용	LOAD	% RPM	LB-FT	BHP	LB/HR	LB/BHP-HR	BMEP
	Ø	26 IDLE					
:	100	100 2600 RATED	359	177	89.9	Ø•5Ø5	116.1
	Ø	110	33	18	32.0	1.768	10.6
	100	75	423	157	69.4	Ø.441	136.8
	100	6Ø	387	114	50.4	Ø.439 .	125.2
	7Ø [*]	105	26Ø	134	74.6	Ø.555	84.1
	100	69	418	143	61.5	Ø.429	135.2
	5Ø	60	185	54	27.2	Ø . 494	59.8

FRDF CONTENT:

78 VOL% DF2

10 VOL% SURFACTANT (EMULSIFIER)

Table 5-74. Performance Test Data (at the end of 300-Hour)

Program of 10-hours Endurance Test with Fire Resistant Diesel Fuel (FRDF)

Performance Data were Printed-out at the End of 300-Hour Endurance Test

Endurance Test Hours 300

Total Operating Hours 364

8	LOAD	% RPM	LB-FT	BHP	LB/HR	LB/BHP-HR	BMEP
	Ø	26 IDLE					
	100	100 2600 RATED	351	173	88.3	Ø . 507	113.5
	Ø	110	35	19	31.5	1.640	11.3
	100	75	398	147	66.5	Ø . 45Ø	128.7
	100	60	384	. 113	50.0	Ø . 438	124.2
	7Ø	105	259	133	75.2	Ø . 562	83.8
	100	69	405	138	60.9	Ø.439	131.0
	5Ø	60	178	52	26.6	Ø . 5Ø2	57.6

- 78 VOL% DF2
- 10 VOL% SURFACTANT (EMULSIFIER)
- 12 VOL% WATER

Table 5-75. Performance Test Data (at the end of 310-Hour)

Program of 10-hours Endurance Test with Fire Resistant Diesel Fuel (FRDF)

Performance Data were Printed-out at the End of 310-Hour Endurance Test

Endurance Test Hours 310

Total Operating Hours 374

%	LOAD	% RPM	LB-FT	BHP	LB/HR	LB/BHP-HR	BMEP
	Ø	26 IDLE		~-	*******		
	100	100 2600 RATED	356	176	89.6	Ø . 5Ø8	
	Ø	110	3Ø	16	30.9	1.875	
	100	75	427	158	69.8	0.440	-0.00
	100	6ø	392	116	50.6	Ø . 434	
	70	1ø5	256	132	72.2	Q.544	
	100	69	409	140	60.8	Ø.434	
	5Ø	6Ø	181	54	26.Ø	Ø.481	-

FRDF CONTENT:

78 VOL% DF2

10 VOL% SURFACTANT (FMULSIFIER)

Table 5-76. Performance Test Data (at the end of 320-Hour)

Program of 10-hours Endurance Test with Fire Resistant Diesel Fuel (FRDF)

Performance Data were Printed-out at the End of 320-Hour Endurance Test

Endurance Test Hours 320

Total Operating Hours 384

કૃ	LOAD	% RPM	LB-FT	BHP	LB/HR	LB/BHP-HR	BMEP
	Ø	26 IDLE			*****		
	100	100 2600 RATED	352	174	88.6	Ø . 5Ø8	113.9
	Ø	110	32	17	30.2	1.744	10.3
	100	75	417	154	68.3	Ø.441	134.9
	100	60	385	114	50.6	0.442	124.5
	7Ø	1ø5	248	128	71.3	0.555	80.2
	100	69	415	142	62.4	Ø . 439	134.2
	5Ø	60	180	53	26.5	Ø.495	58.2

FRDF CONTENT:

78 VOL% DF2

10 VOL% SURFACTANT (EMULSIFIER)

Table 5-77. Performance Test Data (at the end of 330-Hour)

Program of 10-hours Endurance Test with Fire Resistant Diesel Fuel (FRDF)

Performance Data were Printed-out at the End of $330\mbox{-Hour}$ Endurance Test

Endurance Test Hours 330

Total Operating Hours 394

%	LOAD	% RPM	LB-FT	BHP	LB/HR	LB/BHP-HR	BMEP
	Ø	26 IDLE					***
	100	100 2600 RATED	354	175	88.8	Ø . 5Ø6	114.5
	Ø	110	3Ø	16	30.5	1.854	9.7
	100	75	421	156	68.8	Ø . 439	136.2
	100	6Ø	387	114	50.7	Ø.441	125.2
	7Ø	1ø5	266	137	74.2	Ø . 54Ø	86.0
	100	69	415	142	62.6	0.440	134.2
	5Ø	6Ø	183	54	26.4	Ø.485	59.2

- 78 VOL% DF2
- 10 VOL% SURFACTANT (EMULSIFIER)
- 12 VOL% WATER

Table 5-78. Performance Test Data (at the end of 340-Hour)

Program of 10-hours Endurance Test with Fire Resistant Diesel Fuel (FRDF)

Performance Data were Printed-out at the End of 340-Hour Endurance Test

Endurance Test Hours 340

Total Operating Hours 404

용	LOAD	% RPM	LB-FT	BHP	LB/HR	LB/BHP-HR	BMEP
	Ø	26 IDLE					
	100	100 2600 RATED	354	175	88.9	Ø . 5Ø7	114.5
	Ø	110	35	19	30.9	1.611	11.3
	100	75	419	155	68.8	0.442	135.5
	100	60	411	152	68.1	Ø . 446	132.9
	7Ø	105	262	135	75.6	Ø.559	84.7
	100	69	424	145	63.2	Ø.435	137.2
	5Ø	60	186	55	26.9	Ø . 486	60.1

FRDF CONTENT:

78 VOL% DF2

10 VOL% SURFACTANT (EMULSIFIER)

Table 5-79. Performance Test Data (at the end of 350-Hour)

Program of 10-hours Endurance Test with Fire Resistant Diesel Fuel (FRDF)

Performance Data were Printed-out at the End of 350-Hour Endurance Test

Endurance Test Hours 350

Total Operating Hours 414

용	LOAD	% RPM	LB-FT	BHP	LB/HR	LB/BHP-HR	BMEP
	Ø	26 IDLE	2		2.8	_	Ø . 6
	100	100 2600 RATED	356	176	88.6	Ø . 5Ø2	115.2
	Ø	110	3Ø	16	31.0	1.937	9.7
	100	75	426	158	69.7	Ø . 440	137.8
	100	60	391	116	50.8	Ø.437	126.5
	7Ø	1Ø5	259	133	74.6	Ø . 557	83.8
	100	69	424	145	63.5	Ø . 436	137.2
	5Ø	6Ø	182	54	26.8	Ø.495	58.8

⁷⁸ VOL% DF2

¹⁰ VOL% SURFACTANT (EMULSIFIER)

¹² VOL% WATER

Table 5-80. Performance Test Data (at the end of 360-Hour)

Program of 10-hours Endurance Test with Fire Resistant Diesel Fuel (FRDF)

Performance Data were Printed-out at the End of 360-Hour Endurance Test

Endurance Test Hours 360

Total Operating Hours 424

8	LOAD	% RPM	LB-FT	BHP	LB/HR	LB/BHP-HR	BMEP
	Ø	26 IDLE		****	4	_	
	100	100 2600 RATED	354	175	89.0	.5Ø8	114.5
	Ø	110	29	15	30.2	1.895	9.3
	100	75	425	157	69.5	Ø.44Ø	137.5
	100	6Ø	388	115	50.6	ø.439	125.5
	70	105	267	137	74.6	Ø . 545	86.4
	100	69	417	142	62.3	Ø.438	134.9
	5Ø	6ø	187	55	27.7	Ø.498	60.5

FRDF CONTENT:

78 VOL% DF2

10 VOL% SURFACTANT (EMULSIFIER)

Table 5-81. Performance Test Data (at the end of 370-Hour)

Program of 10-hours Endurance Test with Fire Resistant Diesel Fuel (FRDF)

Performance Data were Printed-out at the End of $37\emptyset$ -Hour Endurance Test

Endurance Test Hours 370

Total Operating Hours 434

% LOAD	% RPM	LB-FT	BHP	LB/HR	LB/BHP-HR	BMEP
Ø	26 IDLE			3.9		
100	100 2600 RATED	353	174	88.2	•504	114.2
Ø	110	35	19	30.8	1.604	11.3
100	75	417	154	67.8	Ø . 438	134.9
100	. 60	39Ø	115	50.0	0.431	126.2
7Ø	1Ø5	259	133	74.0	Ø . 557	83.8
100	69	418	143	66.0	Ø . 432	135.2
5ø	6Ø	168	49	45.2	0.508	54.3

FRDF CONTENT:

78 VOL% DF2

10 VOL% SURFACTANT (EMULSIFIER)

Table 5-82. Performance Test Data (at the end of 380-Hour)

Program of 10-hours Endurance Test with Fire Resistant Diesel Fuel (FRDF)

Performance Data were Printed-out at the End of 380-Hour Endurance Test

Endurance Test Hours 380

Total Operating Hours 444

욯	LOAD	% RPM	LB-FT	BHP	LB/HR	LB/BHP-HR	BMEP
	Ø	26 IDLE			3.5		
	100	100 2600 RATED	358	177	88.0	.496	115.8
	Ø	110	35	19	30.6	1.593	11.3
	100	75	426	158	68.8	Ø.434	137.8
	100	6Ø	396	117	50.7	0.430	128.1
	7Ø	1ø5	263	135	73.9	Ø.544	85.1
	100	69	422	144	62.0	Ø.428	136.5
	5Ø	6Ø	172	51	25.0	Ø.489	55.6

FRDF CONTENT:

78 VOL% DF2

10 VOL% SURFACTANT (EMULSIFIER)

Table 5-83. Performance Test Data (at the end of 390-Hour)

Program of 10-hours Endurance Test with Fire Resistant Diesel Fuel (FRDF)

Performance Data were Printed-out at the End of 390-Hour Endurance Test

Endurance Test Hours 390

Total Operating Hours 454

% LOAD	% RPM	LB-FT	BHP	LB/HR	LB/BHP-HR	BMEP
Ø	26 IDLE	400 444		4.0		
100	100 2600 RATED	353	174	88.5	•506	114.2
·ø	110	36	19	30.7	1.615	11.6
100	75	416	154	68.Ø	0.440	134.6
100	6Ø	387	115	50.5	Ø.439	125.2
7Ø	105	246	127	72.6	Ø . 569	79.6
100	69	426	145	62.7	Ø.432	137.8
5ø	6Ø	185	54	26.6	Ø.484	59.8

FRDF CONTENT:

78 VOL% DF2

10 VOL% SURFACTANT (EMULSIFIER)

12 VOL% WATER

NOTE: DELIVERY VALVE GASKET OF THE FUEL INJECTION PUMP FAILED AT 388 DURABILITY TEST HOUR

Table 5-84. Performance Test Data (at the end of 400-Hour)

Program of 10-hours Endurance Test with Fire Resistant Diesel Fuel (FRDF)

Performance Data were Printed-out at the End of 400-Hour Endurance Test

Endurance Test Hours 400

Total Operating Hours 467

કૃ	LOAD	% RPM	LB-FT	BHP	LB/HR	LB/BHP-HR	BMEP
	Ø	26 IDLE			3.5	_	
	100	100 2600 RATED	356	176	89.0	•505	115.2
	Ø	110	34	18	30.0	1.661	11.0
	100	75	432	16Ø	70.6	0.440	139.7
	100	6Ø	393	116	50.8	Ø . 438	127.1
	70	1ø5	258	133	73.3	Ø . 551	83.4
	100	69	431	147	63.7	Ø . 433	139.4
	5Ø	60	188	55	26.7	Ø.485	60.8

⁷⁸ VOL% DF2

¹⁰ VOL% SURFACTANT (EMULSIFIER)

¹² VOL% WATER

Table 5-85. Properties of Reference Diesel Fuels

Pro	operty	No. 7225	No. 8821
			Fed. Spec.
Specification ?	Гуре	MIL-F-46162A(MR)-II	VV-F-800b-DF-2
Gravity, API		36.1	35.2
Density, g/mL a		0.844	0.848
Flash Point, Pl	MCC, °C(°F)	60 (140)	72 (161)
Fire Point, °C Cloud Point, °C	(°F)	91 (196)	84 (183)
Cloud Point, °C	C(°F)	-21 (-6)	-1 (30)
Pour Point, °C	(°F)	-24 (-11)	-10 (14)
Kinematic Visco	osity, cSt at 40°C	2.2	3.2
Accelerated Sta	ability		
(ASTM D 2274)), mg/100 mL	0.6	2.7
Total Acid No.	, mg KOH/g	0.01	0.03
Steam Jet Gum,	mg/100 mL	3.9	3.2
Sulfur, wt%		0.35	0.47
Copper Strip Co	orrosion		
(ASTM D 130)		1 A	1 A
Carbon, wt%		86.8	86.7
Hydrogen, wt%		13.2	13.3
	tion (Gross), J/kg	45.1 x 10 ⁶	45.7×10^6
(Btu/lb)		(19.427)	(19.670)
	ion (Net), J/kg	42.5×10^6	42.8×10^6
(Btu/1b)		. (18,283)	(18,450)
Hydrocarbon Typ	es.		. , .
FIA, vol%	saturates	400 400	69.1
,	aromatics	40 41 40	29.4
Hydrocarbon Typ	es.		
HPLC, wt%	saturates	72.5	74.1
	aromatics	27.5	25.9
Aromatic Ring (
UV, wt%	mononuclear	7.08	7.50
	dinuclear	11.47	6.54
	trinuclear	0.31	0.36
	total	18.86	14.40
Cetane No.		48	51
- · · · · · · · · · · · · · · · · · · ·	ASIM D 86), °C(°F)		•
Initial Boili		166 (331)	183 (362)
10% Distilled		219 (426)	225 (437)
50% Distilled		244 (471)	282 (539)
90% Distilled		296 (565)	331 (628)
End Point	-	358 (676)	361 (682)
		430 (010)	301 (002)

100 GALLON/HR

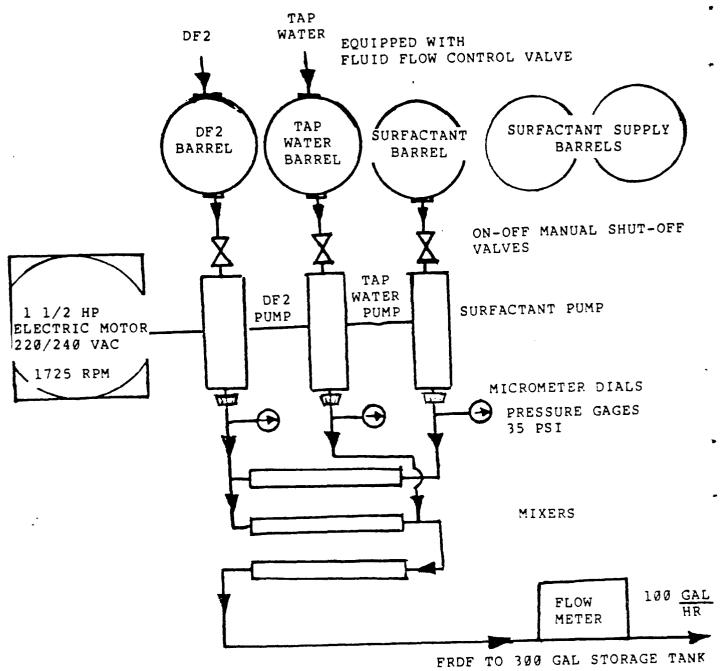


Figure 5-1. Schematic Flow Diagram of FRDF Blending System

46 1323

0

KEUFFEL & ESSER CO. MADE IN U.S.A.

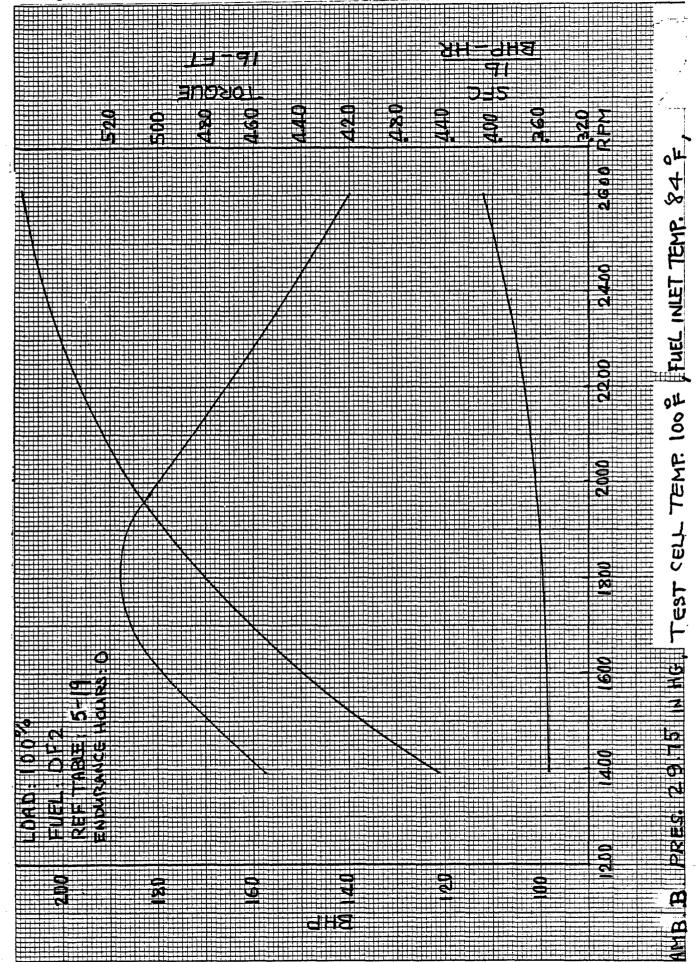


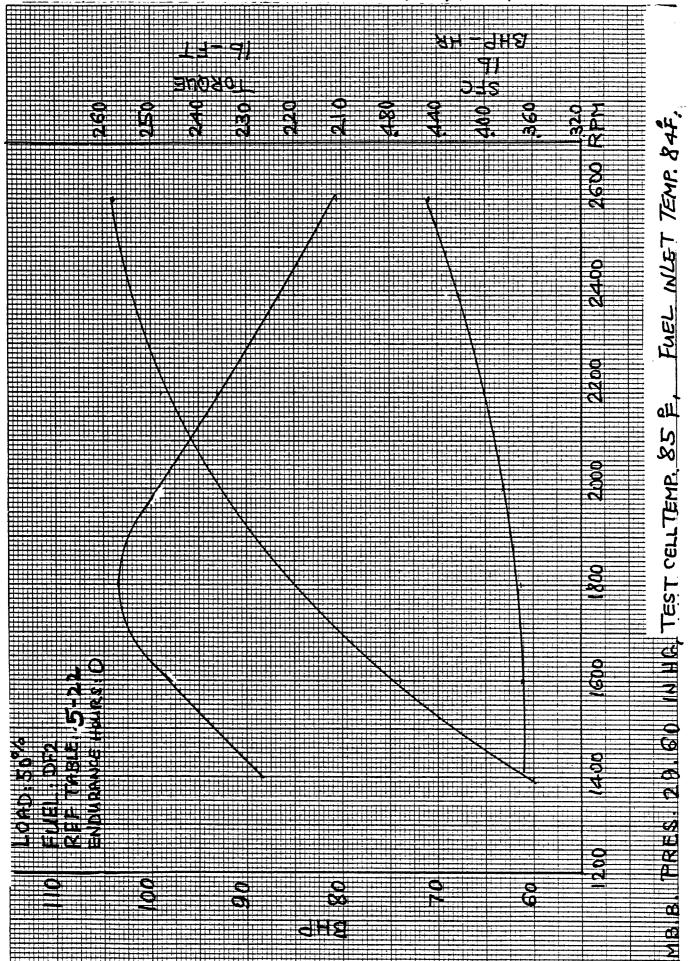
Figure 5-3. Performance Test Diagram (85% Load, DF2, 0-Hour) अस- सह OROUE 2£C 88 360 M 84 F P, FUEL INLET TEMP. IN HOUTEST CELL TEMP. 74 PRES. 29.62 90

Performance Test Diagram (70% Load, DF2, 0-Hour) Figure 5-4. त्रम - वमहा TOROUE 280 SO ST FUEL INLET TEMP. 00 73 73 QLL **2**5 TEST CELL TEMP. 800 PRES 0 20 8 **SHP**

 چ

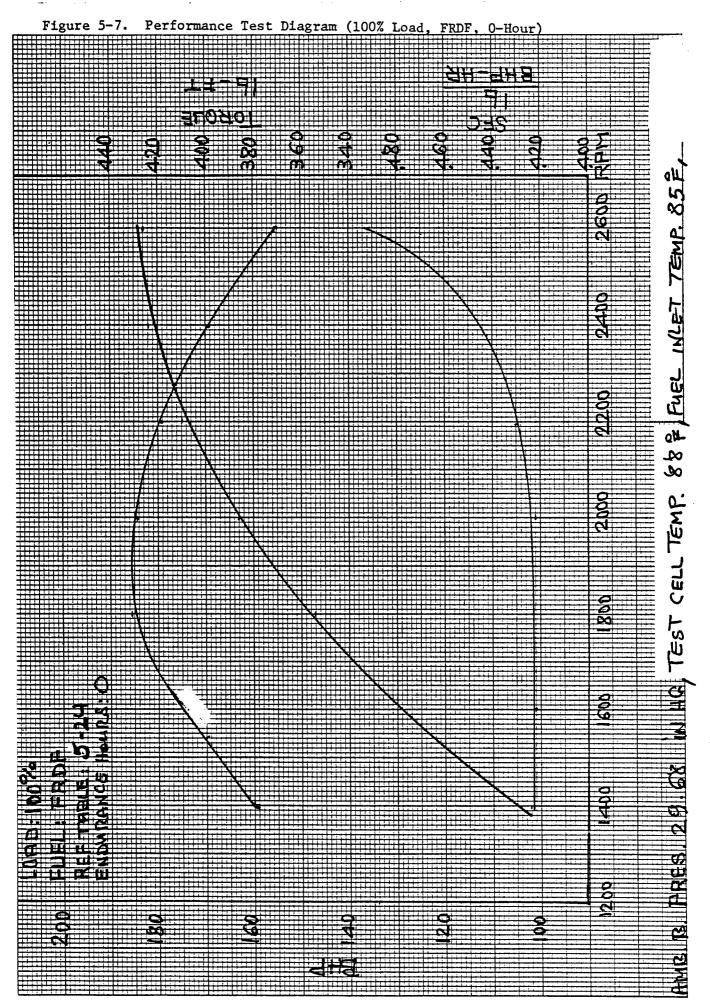
46 1323

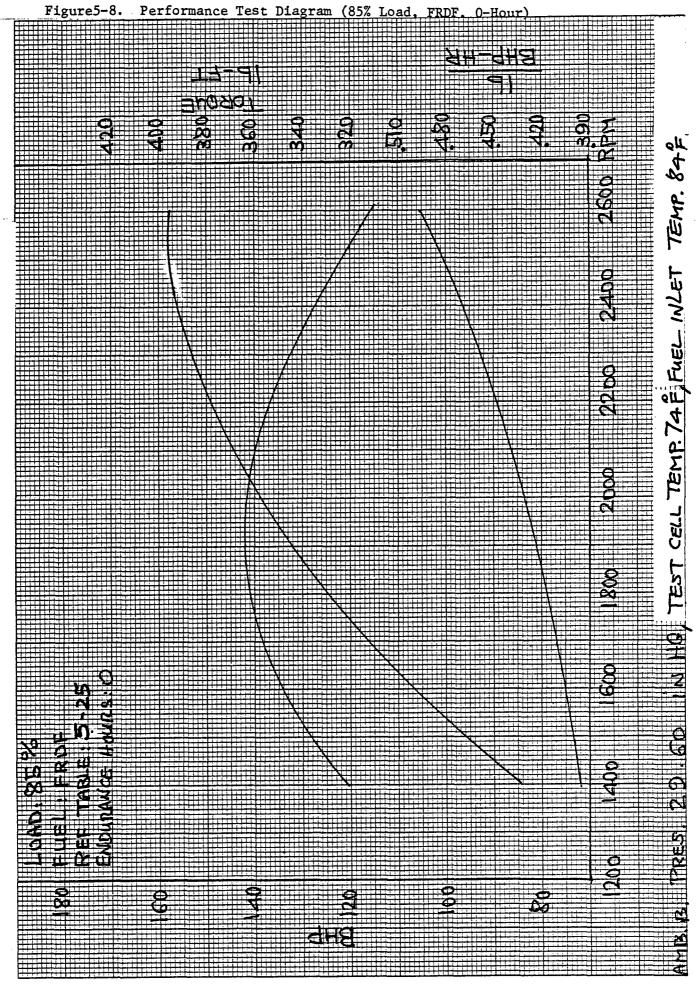
KOE 10 X 10 TO M INCH 7 X 10 INCHES KEUFFEL & ESSER CO. MADE IN USA



46 1323 *

K-10 X 10 TO N INCH 7 X 10 INCHES





Performance Test Diagram (70% Load, FRDF, 0-Hour) Figure 5-9. BHP-HR TORQUE 4.90 290 85 P. Fuel INLET TEMP. 83F TEMP TEST CELL 0 129 PRES <u>21</u> TU ਰਜ਼ਬ

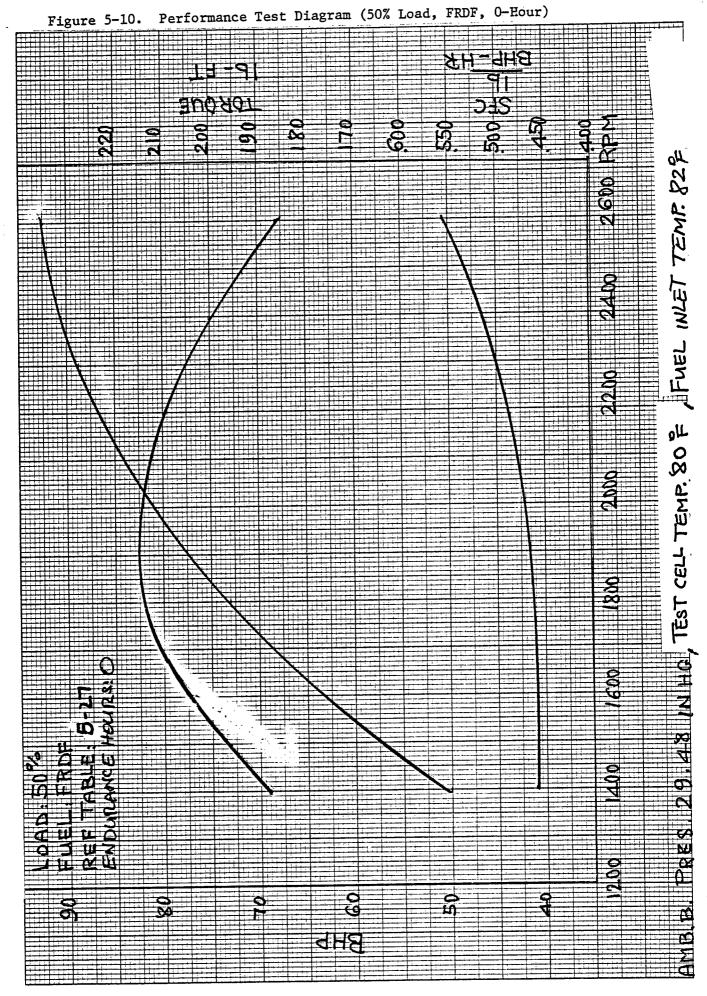
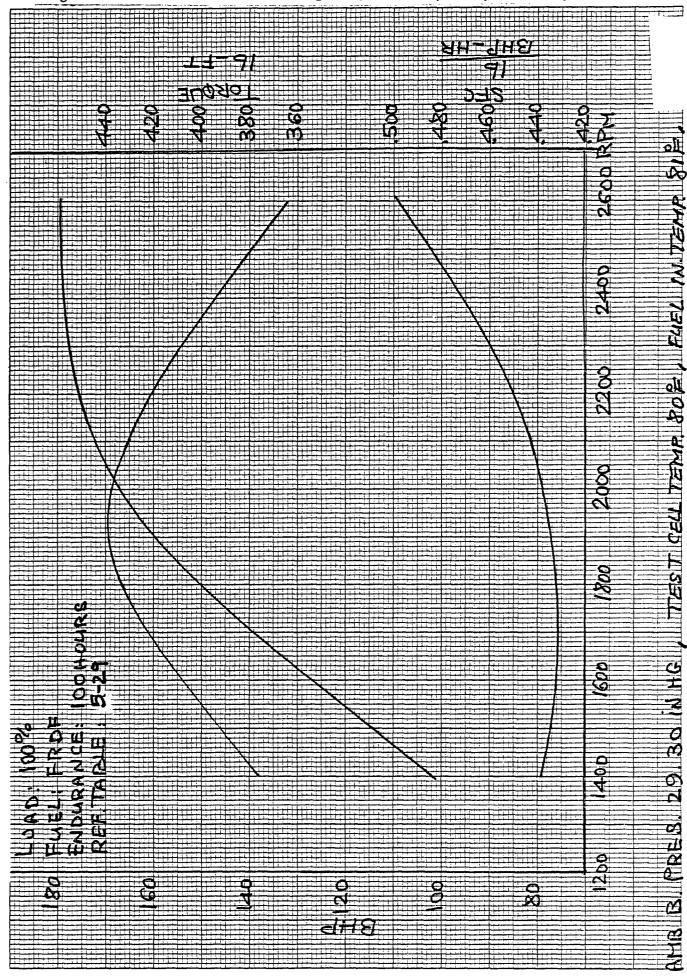


Figure 5-11. Performance Test Diagram (25% Load, FRDF, 0-Hour) HE 448 1080पह 345 0 OK 80 FUEL INCET TEMP olL. TEST CELL TEMP 78

116

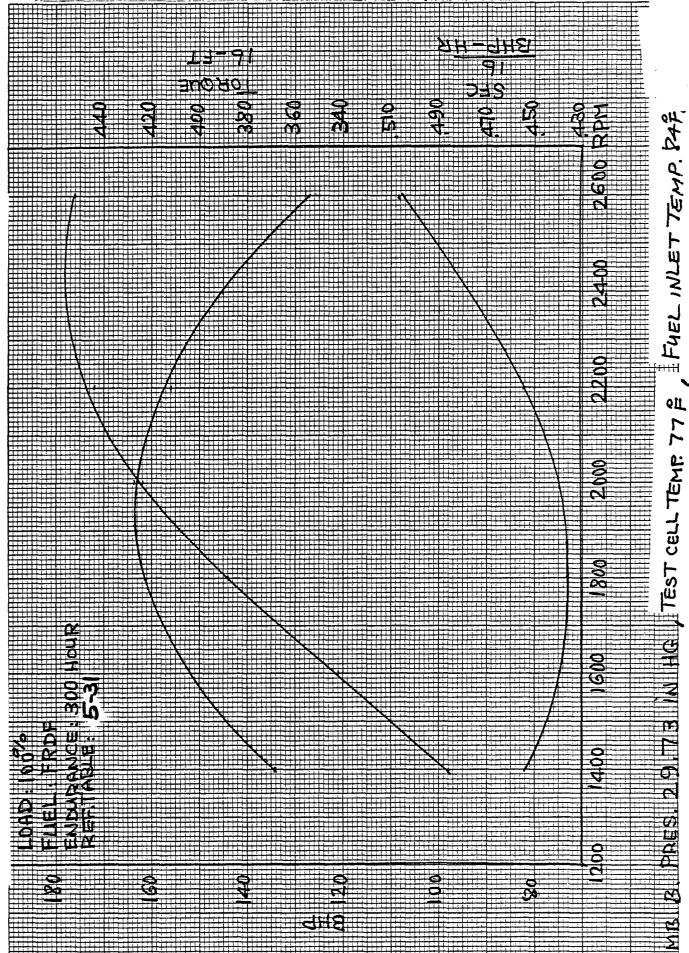
Figure 5-12. Performance Test Diagram (100% Load, FRDF, 100-Hour)



Performance Test Diagram (100% Load, FRDF, 200-Hour) #FUEL INLET TEMP 858 2600 TEST CELL TEMP. 74 P,

46 1323 *

KOE KEUFFEL & ESSER CO. MADE IN U.S.A.



Performance Test Data (100% Load, FRDF, 400-Hour) Figure 5-15. ano yo FUEL INLET TEMP. 84 P TEST CELL TEMP. 818, 80 **GHB**

120

(°;;

Figure 5-16. Performance Test Diagram (85% Load, FRDF, 400-Hour)

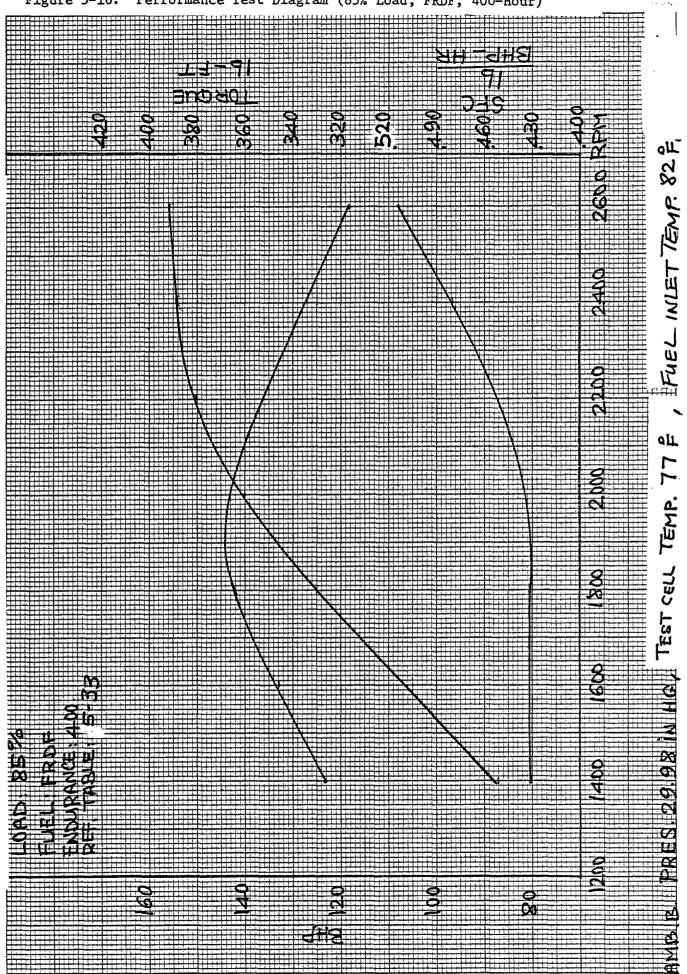


Figure 5-17. Performance Test Diagram (70% Load, FRDF, 400-Hour) धम-बमघ १। २५८ IJ-91 ano ao L 260 20,0 A S T TEMP. ST 9 AMB. B. PREKLIZOLOBINIKOJIESTICENIHIEMA 800 400 H 04R 8 ਰੂਮ੪

46 1323

KS 40 X 10 TO K INCH 7 X 10 INCHES KEUFFEL & ESSER CO. MADE IN U.S.A

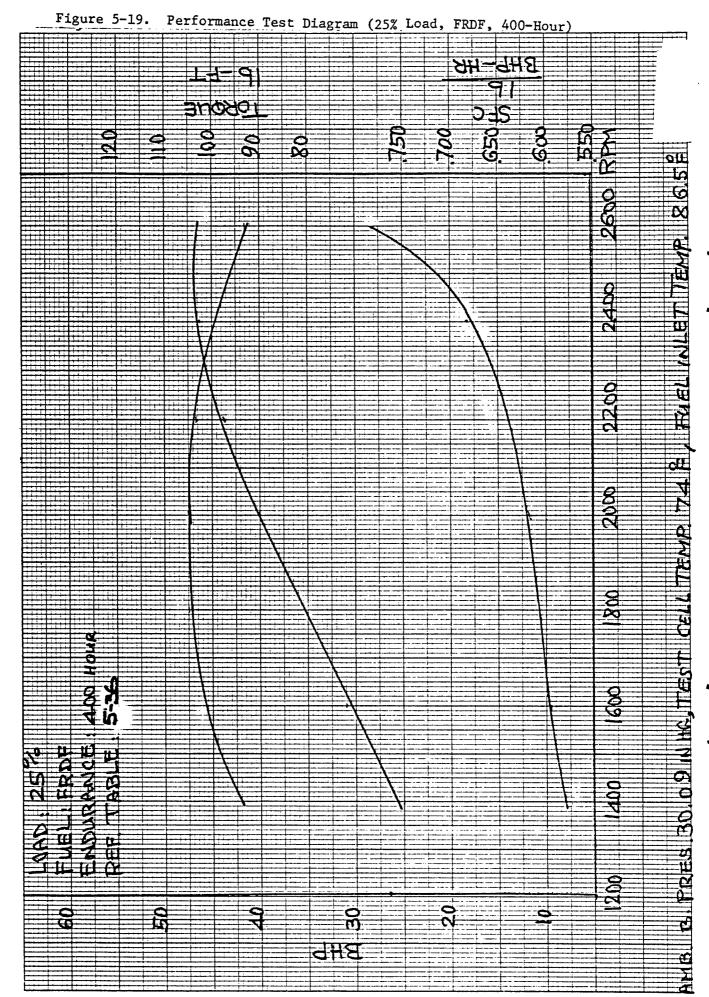
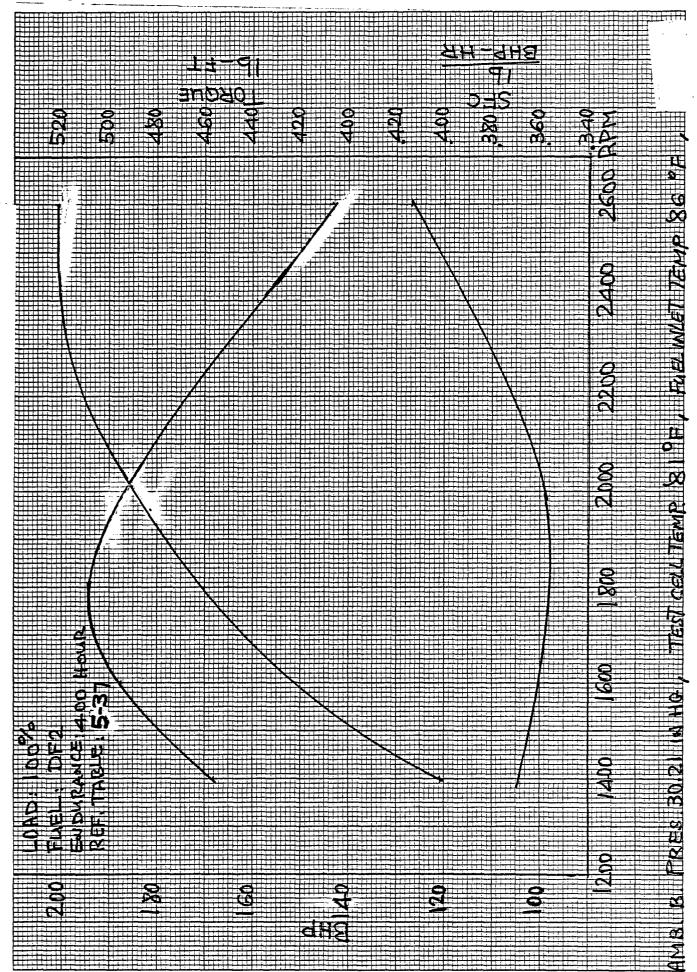


Figure 5-20. Performance Test Diagram (100% Load, DF2, 400-Hour)

(<u>)</u>)

46 1323 *

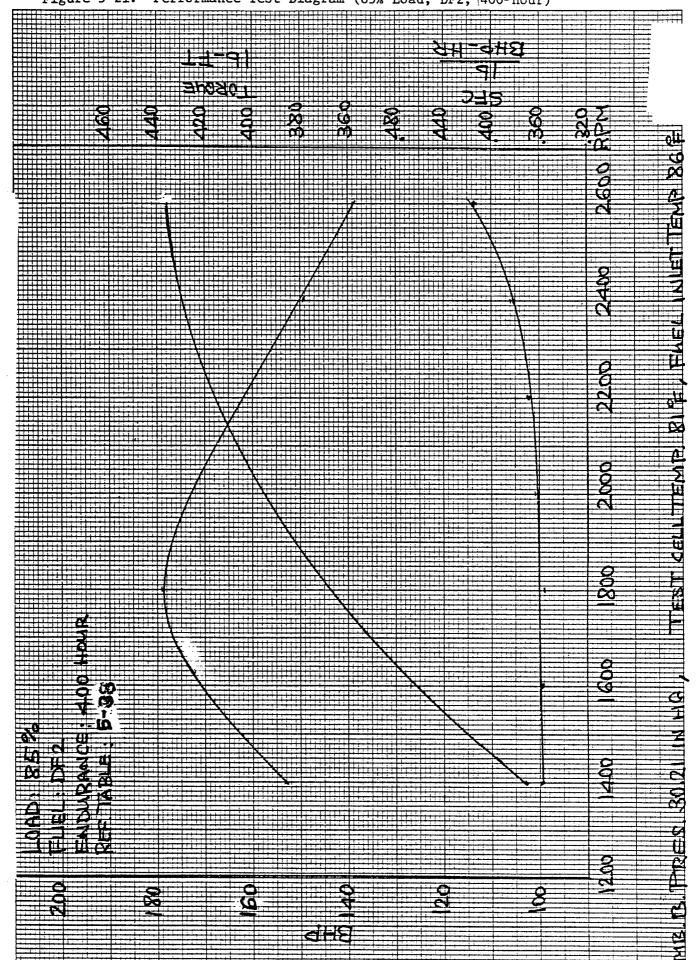
KAE *10 X 10 TO \$4 INCH 7 X 10 INCHES KEUFFEL & ESSER CO. MADE IN U.S.A.



46 1323

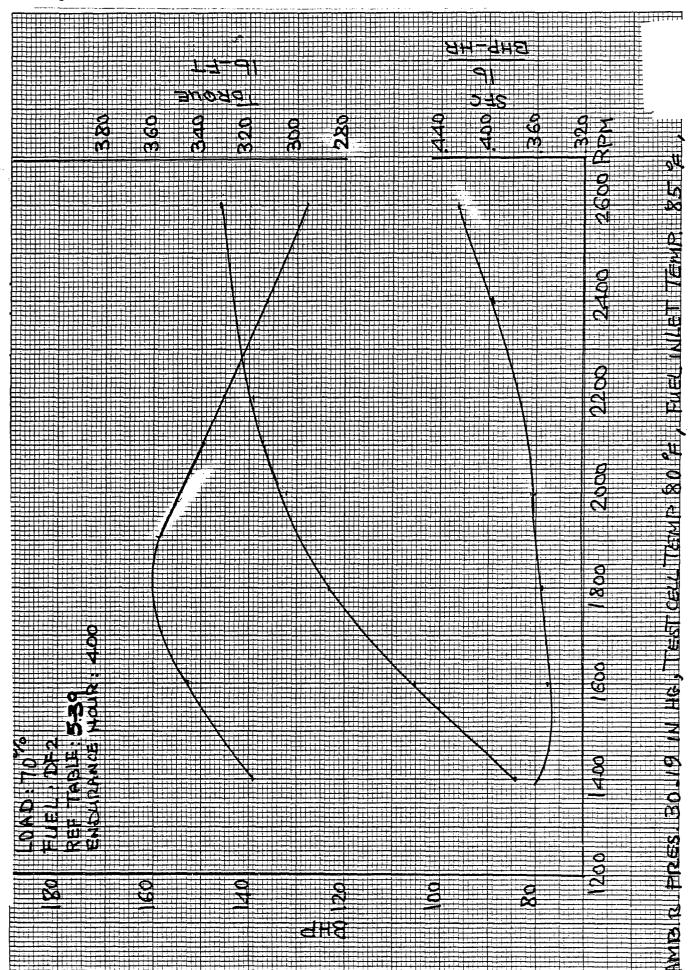
()

KEUFFEL & ESSEN CO. MADE IN USA



46 1323 4

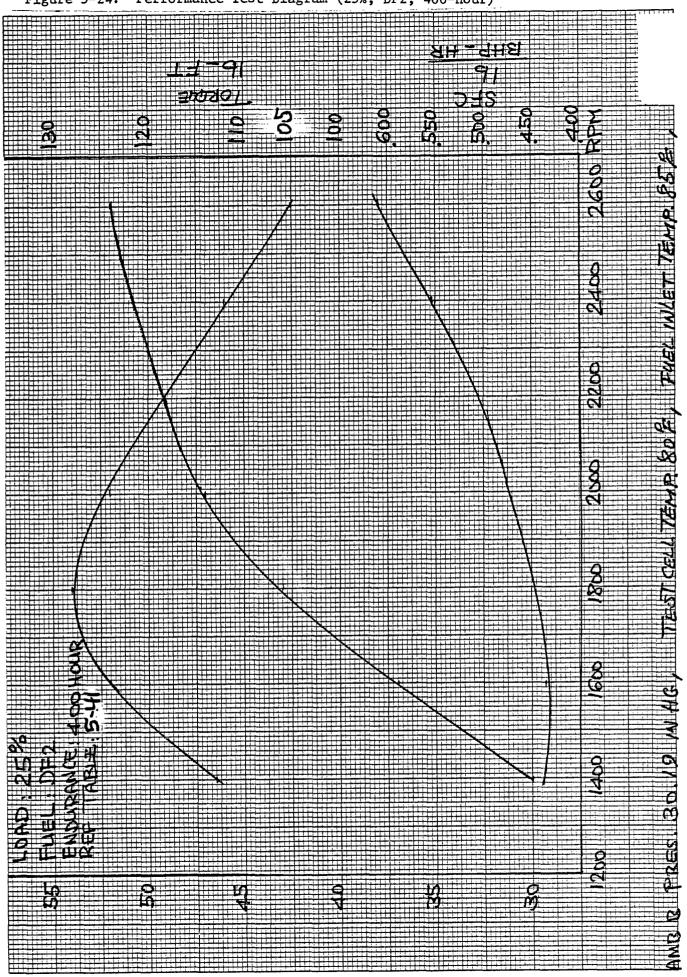
KOE KEUFFEL & ESSER CO. MADE IN U.S.



(-)

46 1323

K-E 10 X 10 TO 15 INCH 7 X 10 INCHES KEUFFEL & ESSER CO. MADE IN USA



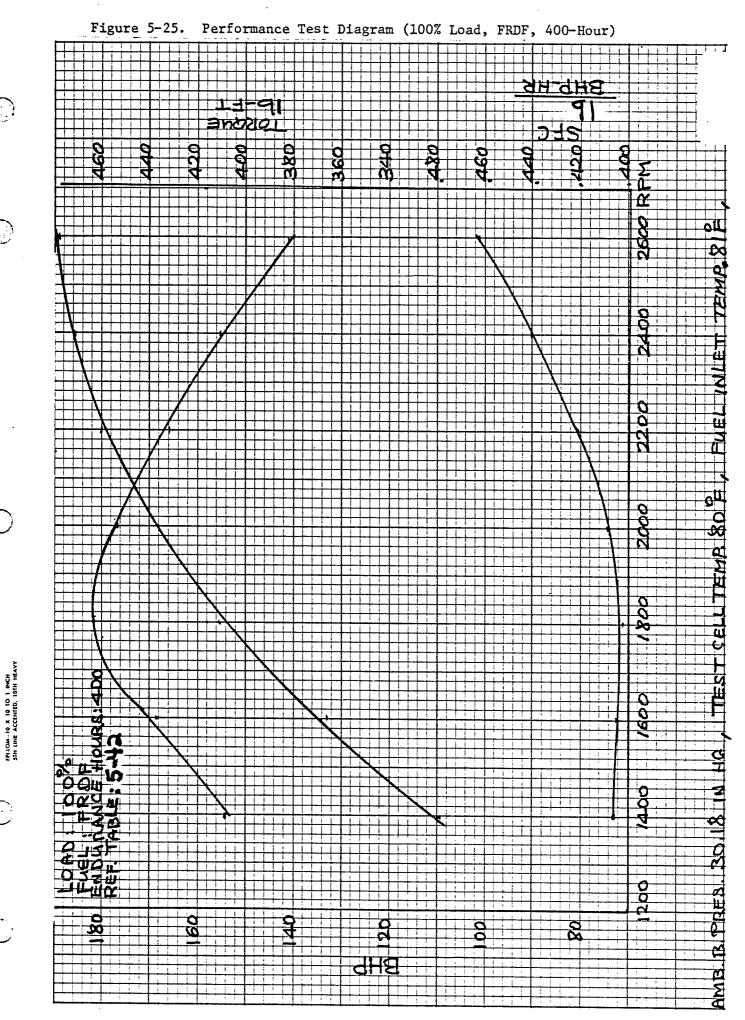
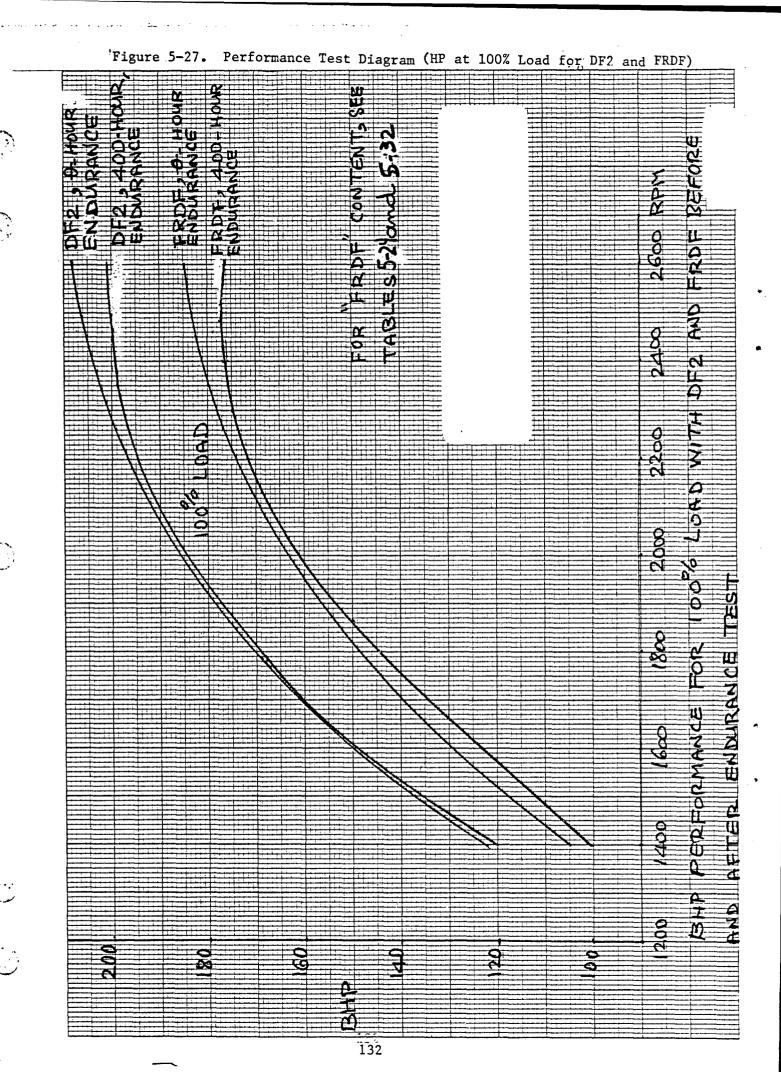


Figure 5-26. Performance Test Diagram (50% Load, FRDF, 400-Hour) FPI-LOM-10 X 10 TO 1 INCHI AMB. B. PRES.



Performance Test Diagram (SFC at 100% for DF2 and FRDF) Figure 5-28. ╫╢╫╫╫╫╫╫╫╫╫╫╫╫╫╫╫╫╫╫╫╫╫╫╫╫╫╫╫╫**╫╫╫╫** REFER TABLES 5-24 and 5-32 CONTENT FOR "FRDF" **DF2** 2200 00) DAR HORN ANCE **S**F

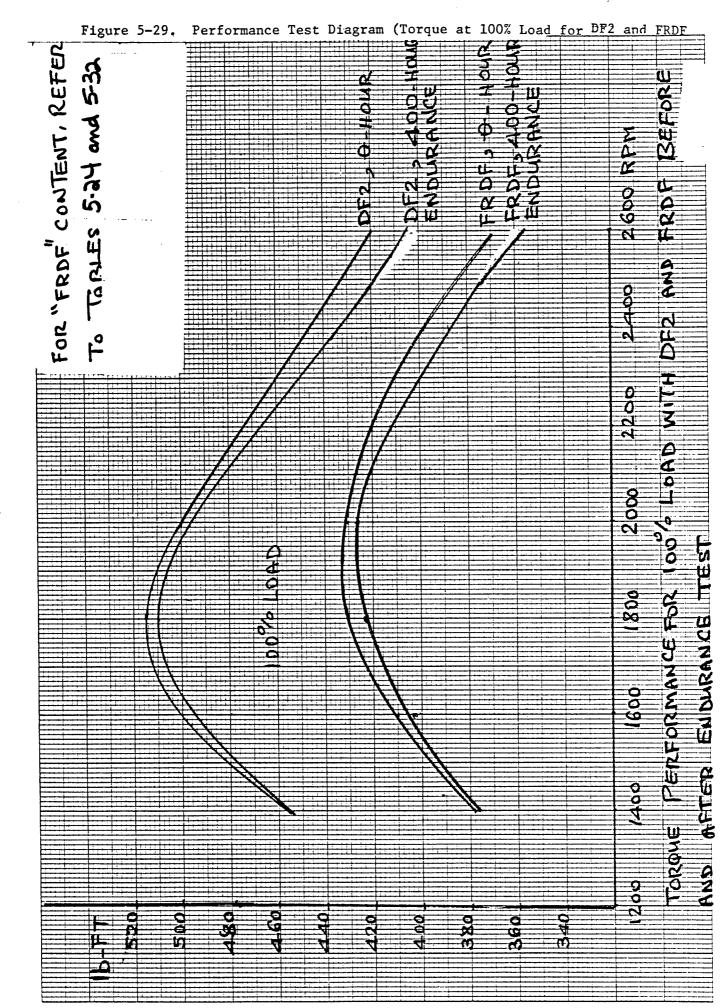


Figure 5-30. Performance Test Diagram (HP at 85% Load for DF2 and FPDF)

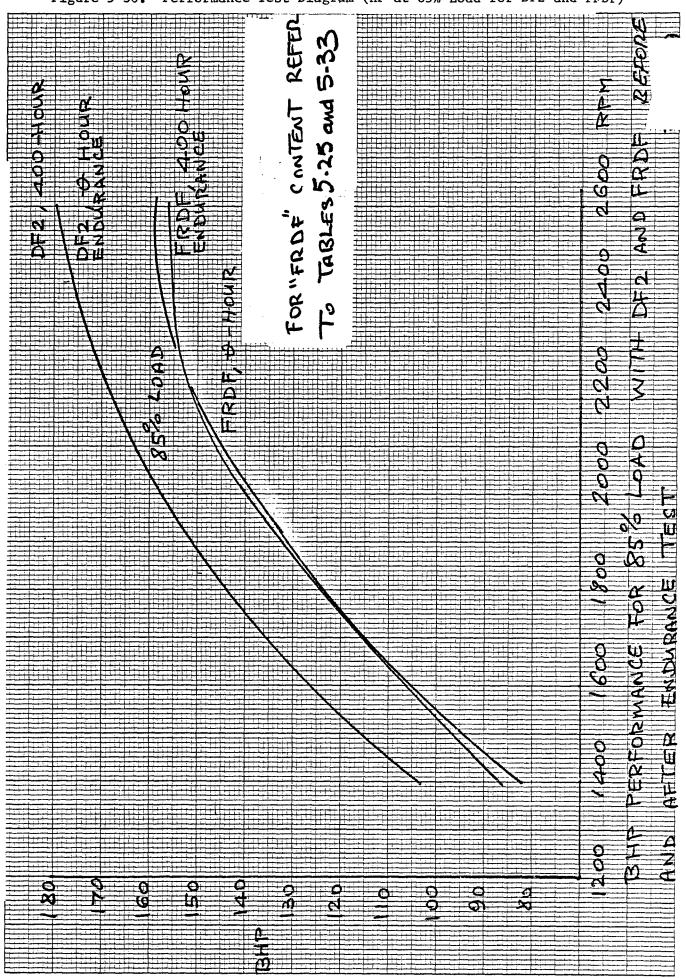


Figure 5-31. Performance Test Diagram (SFC at 85% Load, for DF2 and FRDF) FOR FRDF CONTENT REFER BEFORE TABLES 5-25 and 5-33 4600 255 ∞ FOR FALDURANCE DERHORM ANCE RETIER 400 STO

Figure 5-32. Performance Test Diagram (Torque at 85% Load, for DF2 and FRDF)

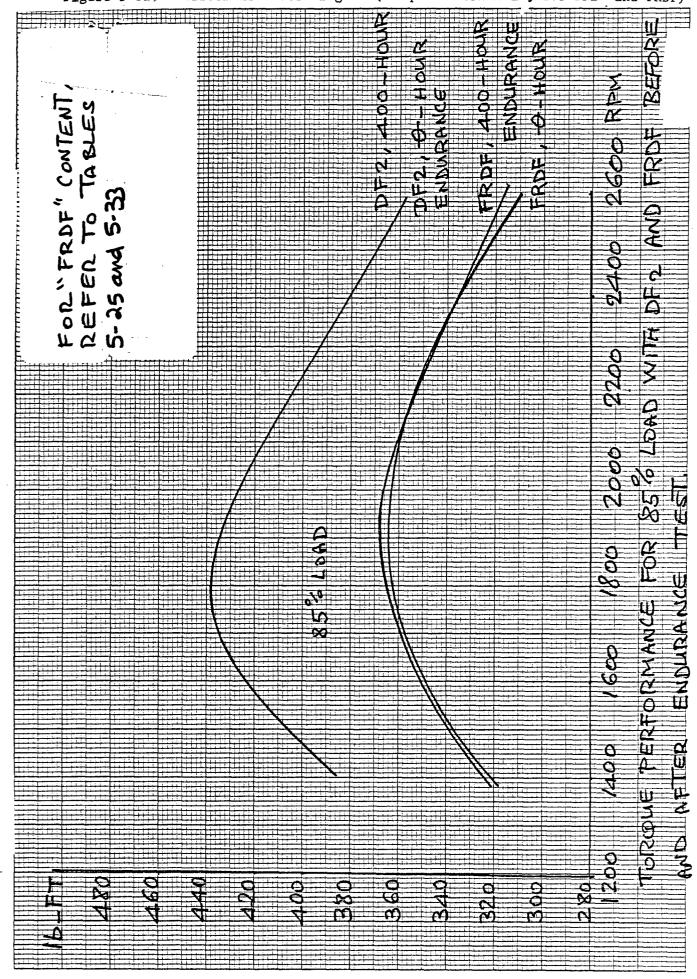
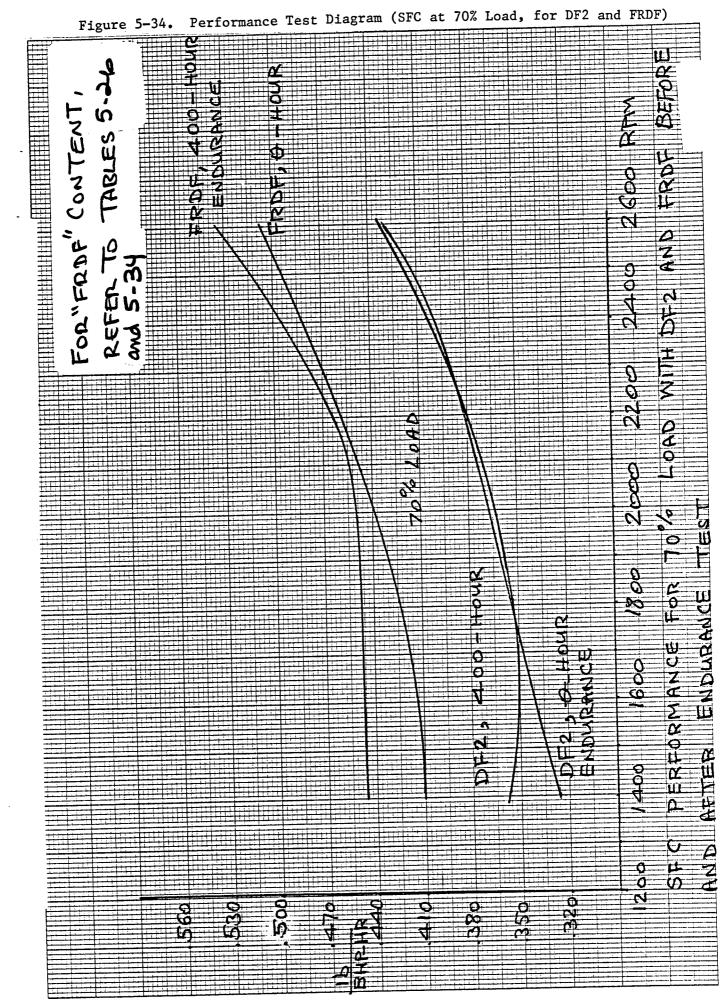


Figure 5-33. Performance Test Diagram (HP at 70% Load, for DF2 and FRDF) 400-HOUR A-HOUR FOR" FRDF" CONTENT, REFER TO TABLES 5-26 and 5-34 DF2 AND FRDE 2600 2200 BAIR PERFORMANCE FOR 70% LOAD 000 Ø



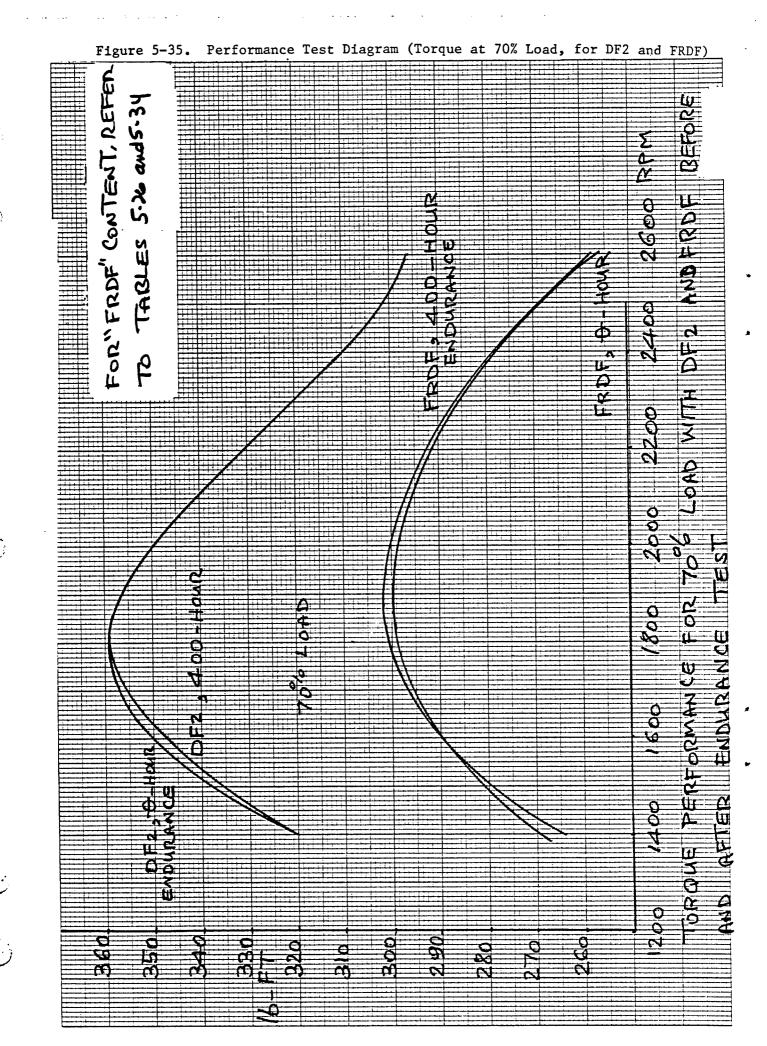


Figure 5-36. Performance Test Diagram (HP at 50% Load for DF2 and FRDF)

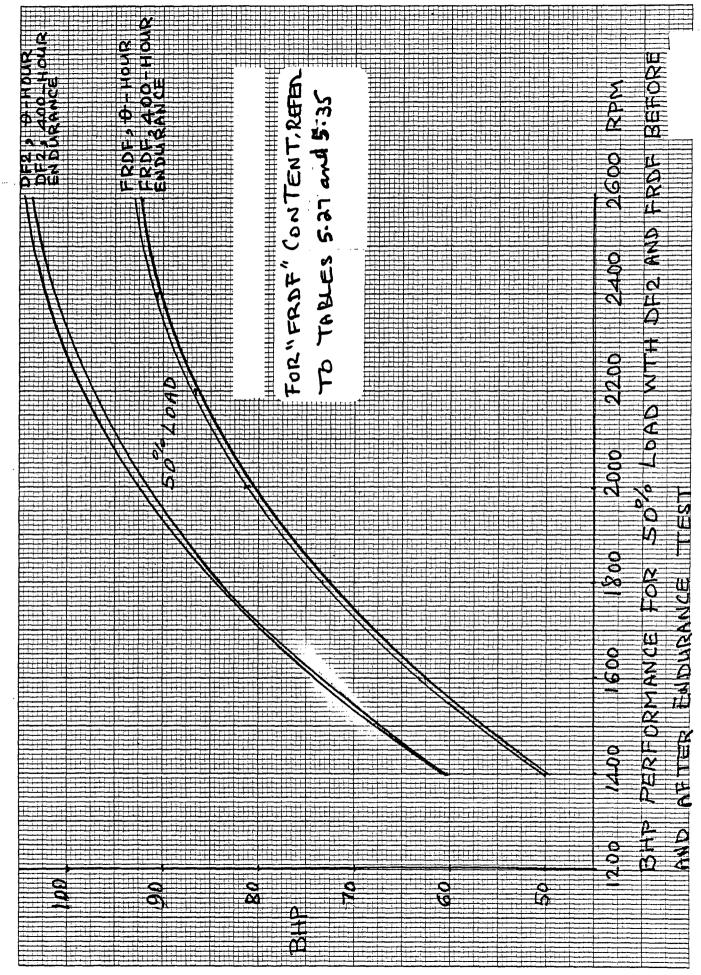


Figure 5-37. Performance Test Diagram (SFC at 50% Load for DF2 and FRDF)

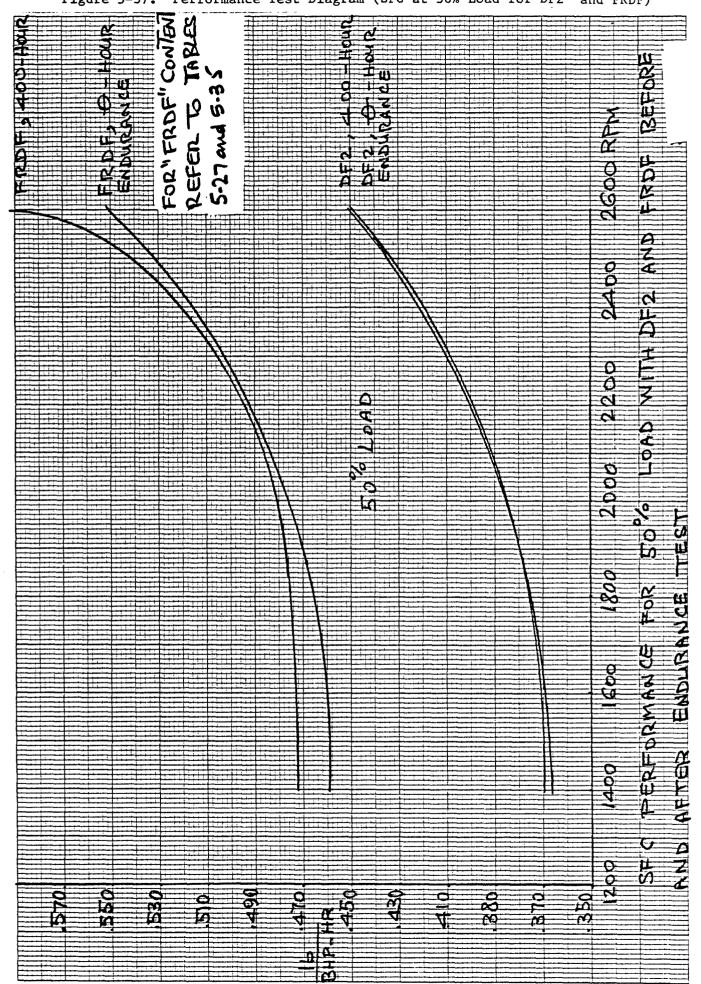


Figure 5-38. Performance Test Diagram (Torque at 50% Load for DF2 and FRDF)

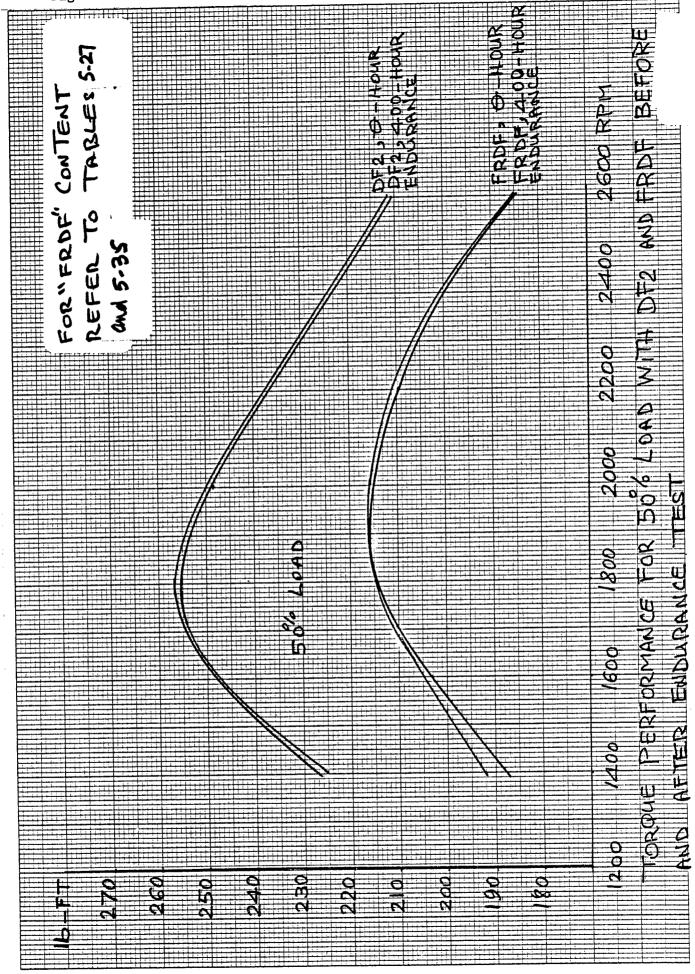


Figure 5-39. Performance Test Diagram (HP at 25% Load for DF2 and FRDF)

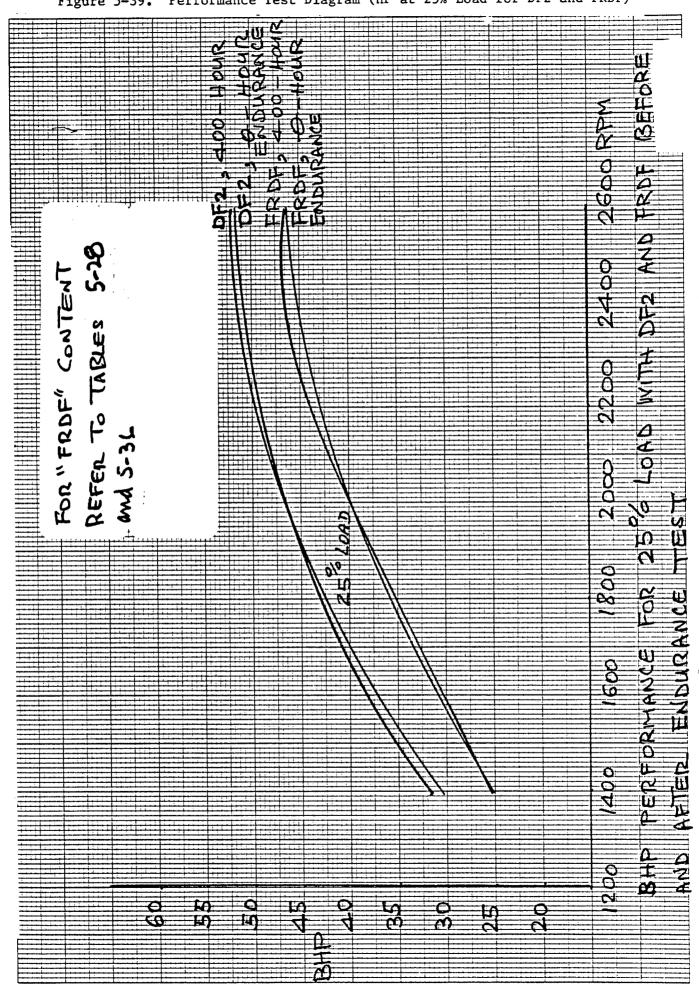


Figure 5-40. Performance Test Diagram (SFC at 25% Load for DF2 and FRDF)

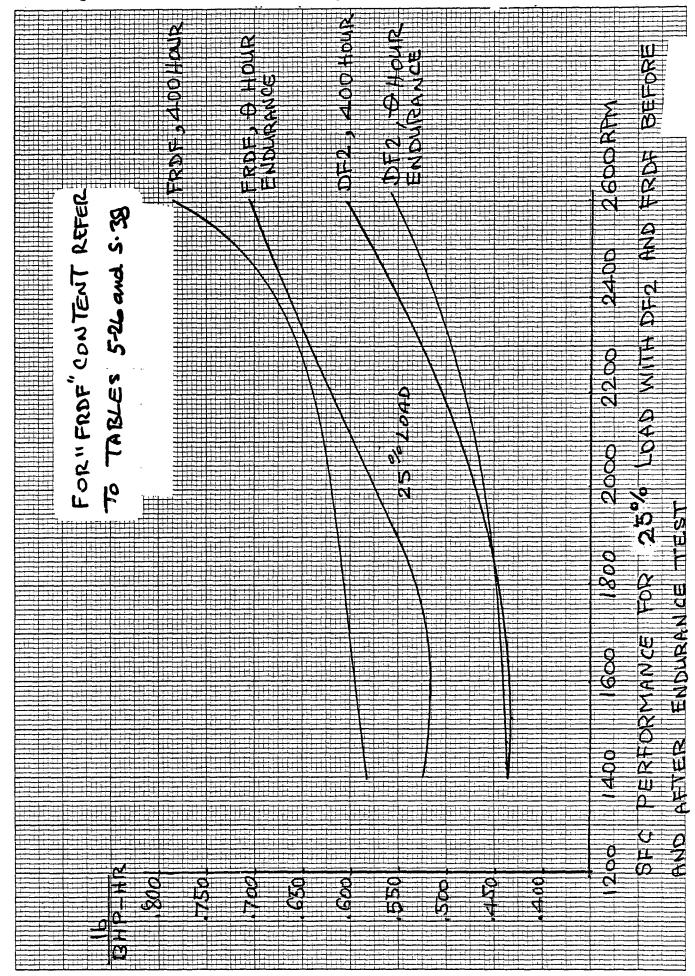
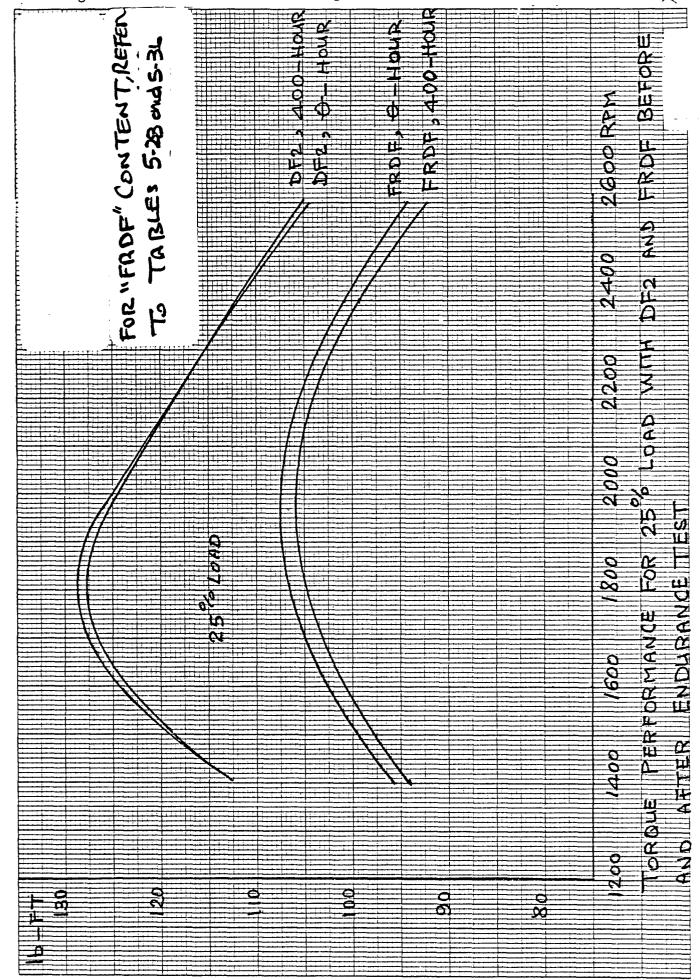


Figure 5-41. Performance Test Diagram (Torque at 25% Load for DF2 and FRDF)



APPENDIX A

ANALYSIS OF FUELS AND LUBRICANTS

BELVOIR FUELS AND LUBRICANTS RESEARCH FACILITY (SWRI) 6220 CULEBRA ROAD - P.O.DRAWER 28510 PH:512-684-5111 SAN ANTONIO, TEXAS 78284

BFLRF

File: 02-8341-113 29 July 1987

Commander
U.S. Army Belvoir Research, Development and Engineering Center
Attn: STRBE-VF, Mr. M.E. LePera
Fort Belvoir, Virginia 22060-5606

Subject: Analysis of the Fuels and Lubricants Used in the TACOM FRF Durability Test

Dear Sir:

Enclosed you will find the results of the analysis conducted at Belvoir Fuels and Lubricants Research Facility (SwRI) on the fuels and lubricants used in the FRF durability test. Brief interpretative discussions are also included.

If you have further questions, please do not hesitate to call.

Very truly yours,

S.J. Lestz Director

B.R. Wright

Manager

Special Projects

SJL/BRW/lap (BRW1.N)

Enclosure

cf: U.S. Army Belvoir Research, Development and Engineering Center, Attn: STRBE-VF, Mr. F.W. Schaekel
Commander, U.S. Army Tank-Automotive Command, Propulsion Systems Division, Attn: AMSTA-RGE, Mr. M. Mekari, Warren, MI 48397-5000

400-HOUR NATO CYCLE EVALUATION OF FIRE-RESISTANT FUEL (FRF) CONDUCTED AT USATACOM

This report summarizes the results of analysis on the fire-resistant fuel (FRF) that was utilized in the 400-hour NATO cycle test to evaluate the engine compatibility with the water-containing fuel. Oil samples taken at 50-hour intervals were also analyzed for fuel dilution or engine distress related to the use of this special fuel blend.

The concern over the water content of the fuel stemmed from the fact that the regulation of the in-line blender was difficult to maintain constant. Therefore, if power loss is being calculated based on water content, precise control of water content was mandatory.

Fuels

TABLE 1 summarizes the results of water analysis that was conducted at Belvoir Fuels and Lubricants Research Facility (BFLRF) at Southwest Research Institute.

TABLE 1. Water Analyses of FRF Samples

Analysis Date	Sample ID	Water Content, vol%
08-29-86	TACOM Blend 07-30-86	10.4
08-29-86	TACOM Blend 08-25-86	11.6
09-09-86	57/57/73	13.2
09-09-86	57/70/73 Top of Tank	10.6
09-09-86	57/70/73 Bottom of Tank	11.8
09-09-86	From Cell	10.8
09-18-86	09-12-86 57/57/73	11.3
09-18-86	09-16-86 57/62/74	12.0
10-06-86	10-03-86 57/62/74	13.2
12-03-86	Mixer 57/50/74	10.2
12-03-86	Engine Filter 57/62/73	12.6

It is obvious from the water analysis data that the water content initially blended into the fuel did not remain constant and that there was some separation/enrichment at various positions in the fuel-handling system. TABLE 2 shows the analysis conducted on the two batches of base fuel that were used throughout the testing. The fuel used on this program was procured as DF-2. Specifications for MIL-F-46162B are also included for ready comparison.

Lubricants

Samples of the used lubricant were withdrawn every 50 hours throughout the test duration. These samples were analyzed for changes that commonly occur during extended engine test hours. Basically, there were very few changes that could be identified and none were significant. Unfortunately, samples of the new oil were not available to allow direct comparisons; however, since only minimal changes throughout the test duration were noted, new oil comparisons cannot be considered critical to the overall assessment of the lubricant analysis. The following tables and graphs show the tests that were conducted and the results that were obtained. TABLE 3 shows the results obtained for changes in viscosity, acid and base number. It was not possible to correlate these numbers with make-up since that information was not available. Basically, there were no significant changes in viscosity. The acid number and base number did not show significant changes that would indicate stressing of the oil. Even though the base number did not indicate a high base number, no major reductions (showing acid formation) were observed. TABLE 4 shows the metals that were found in the used oil samples. The iron was low indicating no serious wear problems in cylinder liners and pistons. The bearing materials (primarily lead and copper) showed no distress in the highly loaded bearing areas. There was no significant change in additives as shown in the barium, phosphorous and zinc concentrations.

The next eight graphs are spectrum taken from the infrared analysis of the samples. There are a number of verifications and indications from reviewing these spectra. Basically, there did not appear to be heavy soot loading since there was no major baseline displacement. Moisture or coolant (as diluents) do not appear in the sample and lubricant oxidation (chemical breakdown) does not appear on the spectrum.

In summary, analyses of the lubricant samples taken every 50 hours do not show any indications that the engine was being stressed or that contaminants were entering the oil sump.

A-5

TABLE 2. Analysis of DF-2 Test Fuels

Properties	MIL-F-46162B Requirements	ASTM Test Method	TACOM 07-29-86	TACOM 08-21-86
Density, kg/L at 15°C	Report	D 287 D 287	0.8489 35.1	0.8479 35.3
Gravity, OAPI	NR (a) Report	D 93	75.0	67.2
Flash point, ^o C Distillation, ^o C	Report	D 86		
Initial boiling point	Report			
10% recovered	Report			
50% recovered	245-285			
90% recovered	330-357			-
95% recovered	350-375			
End point	385 max			
Sulfur, wt%	0.95-1.05	D 2622	0.22	0.29
Accelerated stability,				
total insolubles,				
mg/100 mL	1.5 max	D 2274		
Cetane index (b)	40-45	D 976		
Cetane number (b)	40-45	D 613		
Kinematic viscosity at			0.25	2 47
40°C, cSt	1.9-4.1	D 445	2.35	2.47
Cloud point, ^o C	-13 max	D 2500	-25	-18 -19
Pour point, ^o C	-18 max	D 97	-28	-17
Particulate contamination,		D 227/		
mg/L (0.8 μm filter)	10 max	D 2276 (Appendix A2)		
Volume filtered, L	1			
Ash, wt%	0.02 max	D 482		
Carbon residue, 10% bottoms, wt%	0.20 max	D 524		
Neutralization No.				
mg KOH/g	0.2 max	D 974		
Copper corrosion at 50°C	1 max	D 130		
Net heat of combustion,				
Btu/lb	Report	D 240	18313	18283
Aromatics, vol%	Report	D 1319		
Carbon, %			86.86	86.85
Hydrogen, %			12.99	13.04

⁽a) NR = No Requirement. (b) ND = Not Determined.

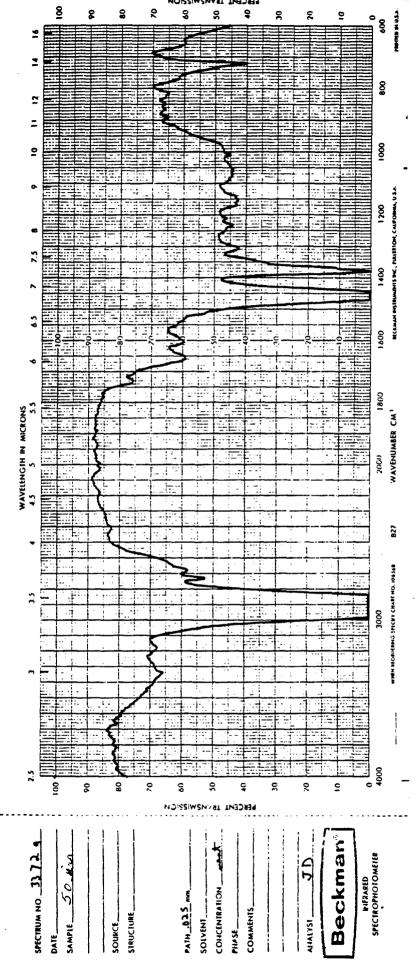
TABLE 3. Used Oil Analysis

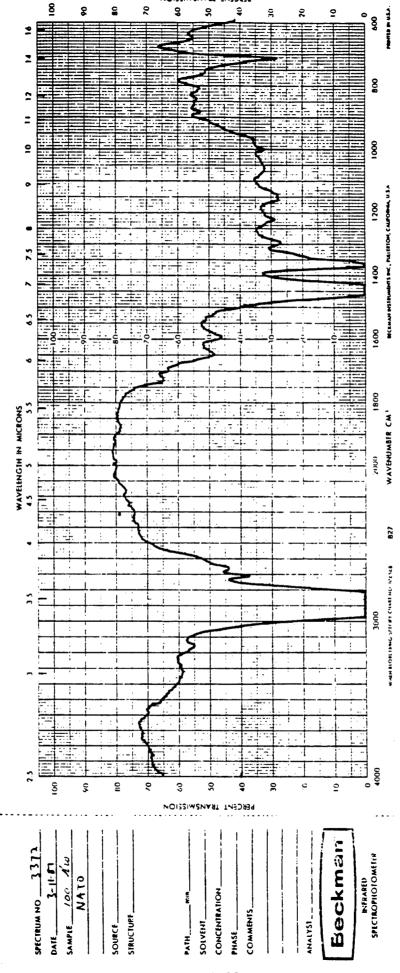
Samples	Kinematic Viscosity at 40°C	Kinematic Viscosity at 100°C	VI	TAN	TBN
50 hrs	95.87 cSt	12.72 cSt	129	3.49	4.53
100 hrs	101.70 cSt	13.53 cSt	133	3.60	4.34
150 hrs	103.84 cSt	13.37 cSt	127	3.22	4.02
200 hrs	110.44 cSt	13.83 cSt	125	3.35	3.43
250 hrs	108.62 cSt	13.75 cSt	126	3.13	4.40
300 hrs	115.21 cSt	14.53 cSt	128	3.48	3.71
350 hrs	108.90 cSt	13.70 cSt	125	2.99	4.01
400 hrs	112.98 cSt	14.38 cSt	129	3.11	3.48

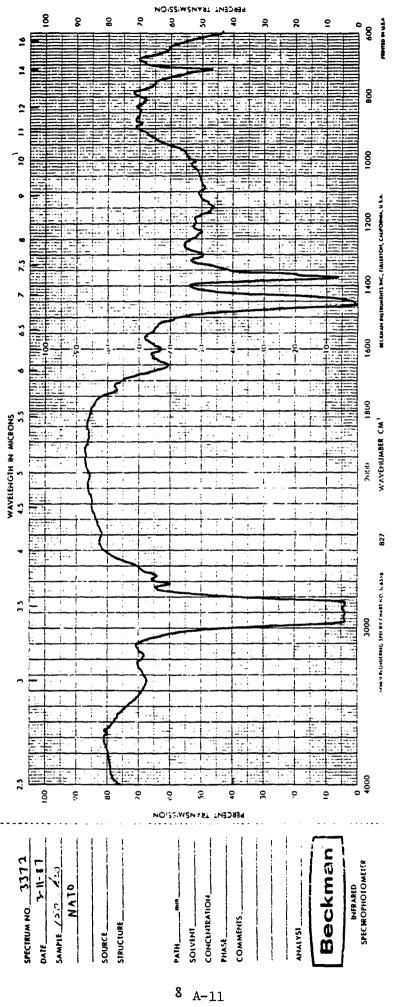
TABLE 4. Metals Found in Used Oil Samples

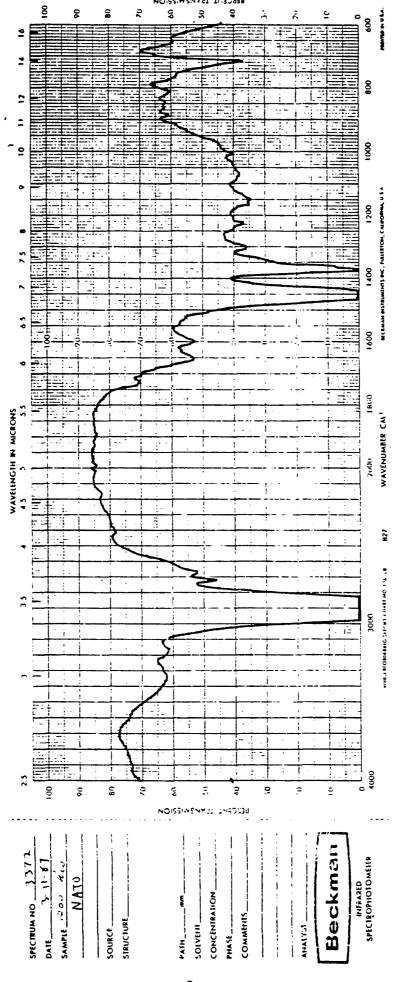
OIL CODE:	ii I	, a	FRF Test	Pb	3	S	₹	Z	MET	METALS IN PPM	PPM	ឆ	•	e Z	Mo	M	<u>ق</u>	88	٩	5
1	,	*	7	2	11/2	7	6	17	7		_	6	66		17	0/9		1>	177/7641	3
1777	5 5	29	7	6	45	1 3	14	-	- ~	- 7		. 0	33		<(\$159		10	1519 174	176
478.6	2 3	15	17	-	. 3	W	7	~	7	7	-	∞	44		~	23/1		7	11831718	(78
002 71.24	2	24	17	m	*	1	4	7	-	7	_	00	18		7>	729	>	~	1495/807	190
Tuit.	3	/3	7	7	7	3	_	7	7	7	>	2	95		7>	600		12	1471177	13
1/1/2	3	23	- 7		35	4	w	_	7	1	_	6	8		~	243	\dashv	7	1549/82	3
1:34 350	So	1 1	>	n	9/	m	4	7	17	7	_	9	86		7	Z		-	148/1752	133
\$ 7c.it,	3	77	1	*	32	7	d	1>	12	77		~	95		17	(27)		10	180/005/	92

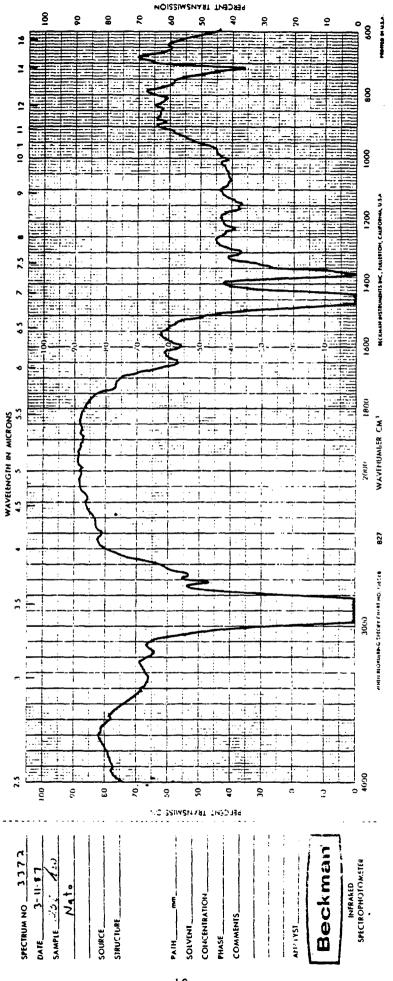
(BRW1.L)

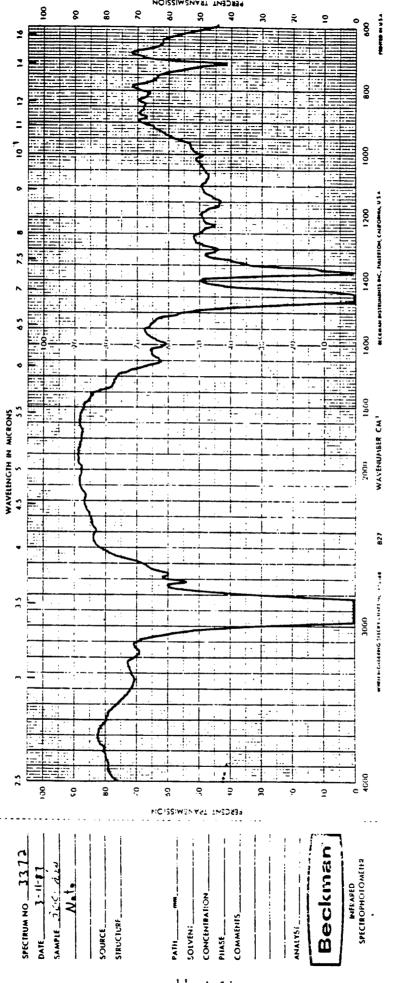


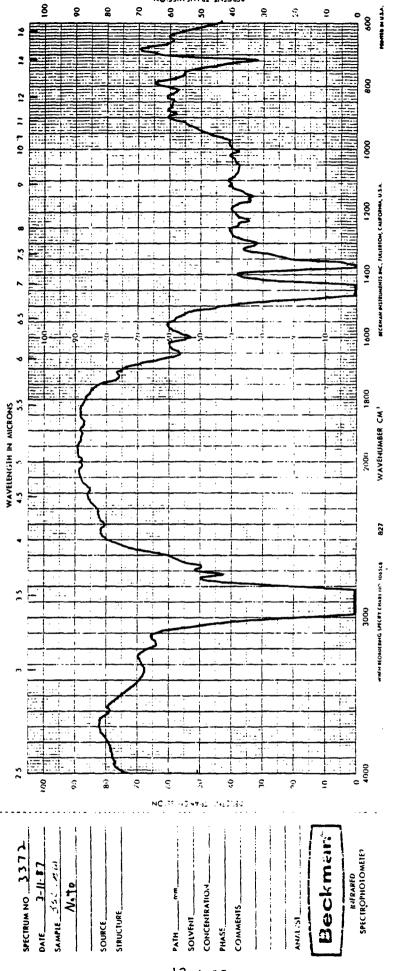


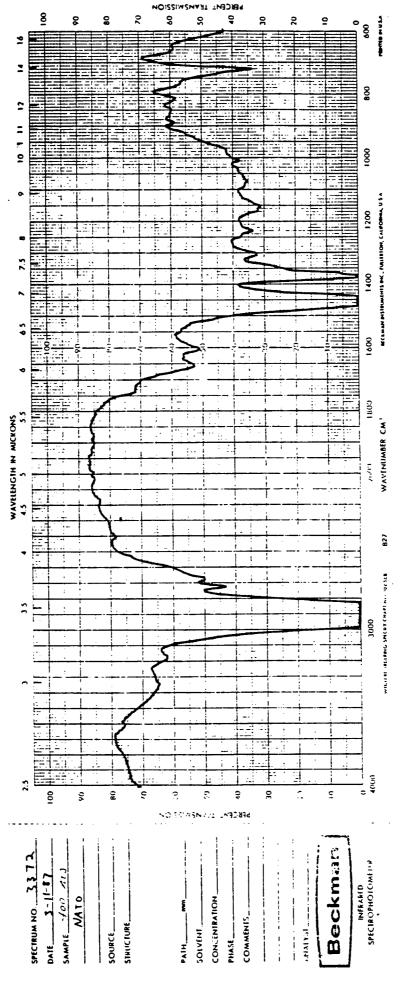












APPENDIX B

NATO STANDARD DIESEL AND SPARK IGNITION ENGINE LAB TEST SPECIFICATIONS

NATO UNCLASSIFIED

PART II

--==00000==--

NATO STANDARD DIESEL AND SPARK IGNITION ENGINES LABORATORY TEST

--==00000==--

AEP-5

JUNE 80 ISSUE

JAN 84 REVISED

--==00000==--

NATO UNCLASSIFIED CHAPTER I

GENERAL - DEFINITIONS

SECTION 1-1 - GENERAL

The purpose of this document is to define a test method and standard conditions to enable all NATO countries to conduct tests using an identical method or to analyze the tests conducted in the laboratories of other NATO countries on the basis of this method.

The method described below is independent of existing national test methods, which may be used for supplementary testing.

When an engine has met the requirements of the tests under the present code, its power rating should be indicated as follow: Rated Power ... kW (... metric HP) at ... r.p.m., in accordance with NATO AEP 5 - june 80 issue.

SECTION 1-2 - FIELD OF APPLICATION

These test requirements are applicable to all military vehicles fitted with Diesel or Spark ignition engines.

75

SECTION 1-3 - DEFINITIONS

A major failure is a failure of any part or component of the engine assembly that leads to a final stoppage of the engine or that brings about a loss of power which cannot be rectified to give at least 95 % of rated power, within the scope of normal maintenance and adjustement.

Any major failure will lead to termination of the test and any retest must start at 0 hour.

Major failures and corrective action are to be reported to the proper National Authority.

A minor failure is a failure which leads to a loss of power or degradation of the operation of the engine and which it is possible to remedy within the scope of normal maintenance and adjustment. If 95 % of the rated power cannot be obtained after normal maintenance then the test will be terminated.

The minor failures and the measures taken to overcome them must be included in the report.

The suitability of an engine for NAȚO AEP 5 is to be the responsibility of the National Authorities after completion of the 400 hours test and consideration of the final condition of the engine.

NOTE: The measurement units must are to be in accordance with the Système International

. .

CHAPTER 2

TEST REQUIREMENTS

SECTION 2-1 - GENERAL COMPOSITION AND ORDER OF TEST

2.1.1. Engine reception.

Running-in in accordance with manufacturer's instructions.

Performance test, complete (full and part loads).

Endurance test.

Performance test, complete (full and part loads).

Disassembly, inspection and measurement.

Report.

NOTES :

- (1) Engine measurements may be carried out before running-in.
- (2) The manufacturer is responsible for defining the running-in program and the engine should have been run-in before it is submitted for testing.
- (3) In so far as possible, the manufacturer's drawing and technical data will be supplied with the engine, to assist inspection and measurement of components.
- (4) It is normal practice for the engine to be given a preliminary performance test immediatly after receipt, to check acceptability.
- (5) If an initial inspection is accomplished, the final one should be carried out by the same inspection team using the same gauges.

- 2.1.2. During performance and durability testing, the following variables will be monitored:
 - a Main values
 Speed (engine output shaft)
 Torque (engine output shaft)

---- <u>1</u>

- b Ambient conditions
 Temperature of ambient air
 Atmospheric pressure
 Humidity
- c Air and gases
 Inlet air temperature
 Inlet or cylinder inlet depression
 Inlet air flow (performance test only)
 Air temperature and pressure in the inlet manifold
 Exhaust temperature
 Exhaust back pressure
- d Lubrication and cooling Oil temperatures and pressures Temperatures into and out of external coolers Flow rates of fluids to cooling devices external to the engine (for heat rejection calculations). Performance test only Oil consumption (during endurance tests only)
- e Fuel
 Fuel temperature
 Fuel consumption
- f Miscellaneous
 Blow-by
 Smoke density

2.1.3. REGULATED PARAMETERS

Outlet temperature of cooling agent a - water + antifreeze = 96°C + 3°C b - other cooling agents = to manufacturers specifications

Inlet Air Depression (*) at rated power : 25 ± 5 mbar
Exhaust Back Pressure (**) at rated power : 40 + 5 mbar

Fuel temperature : at injection pump inlet : 30°C + 3°C

Inlet air temperature: The inlet temperature will be maintained as close as possible to 25°C.

- (*) Depression between static atmosphere and total pressure at the point of measurement.
- (**) Exhaust back pressure between static atmospheric and static pressure at the point of measurement. For small engines, which are sensitive to exhaust back pressure manufacturers' recommended figures should be used

2.1.4. TEST CONDITIONS

Measuring is to be done in normal and stable operating conditions.

The temperature of the air entering the engine (ambient air) is to be measured at a maximum distance of 0,15 m from the air filter inlet or, if there is no filter, 0,15 m from the air inlet nozzle. The thermometer or thermocouple must be protected against heat radiation and be located directly in the air jet. Testing must be carried out in an adequate number of positions to give a representative inlet temperature.

Once an output speed has been selected for measurement purposes, its value must not vary by more than + 1 % or + 10 r.p.m. (whichever of these limits is the higher) during measurement.

The readings for brake load, fuel consumption and inlet air temperature are to be taken simultaneously, the value recorded being the average of two stabilized results, obtained in succession with brake load and fuel consumption differing by less than 2 %.

When a device fitted with an automatic starting system is used for measuring speed and fuel consumption, the duration of measurement must be at least 30 seconds; if the measuring device is manually operated, the duration must be at least 60 seconds.

An instantaneous consumption measuring device may be utilised.

The exhaust gas outlet temperature must be measured at a point downstream and less than 100 mm from the flange(s) of the exhaust manifold(s).

Lubricant temperature is to be measured at the inlet and outlet of the heat exchanger if there is one. Otherwise it must be taken preferably in the lubrication system, or, failing this, in the crank case. The measuring point will be specified in the test report.

Fuel temperature must be read at the injection pump inlet, or carburattor inlet.

Auxiliary power take-offs may be loaded and then measured.

2.1.5. FUELS - LUBRICANTS AND ANTI FREEZES

Engines are to be tested on fuels, lubricants and antifreezes as specified by the relevant NATO Authorities.

2.1.6. MEASUREMENT ACCURACY

- TORQUE

The torque must be accurate within \pm 0,5 % of the highest value to be measured.

- OUTPUT SPEED

Measurement must be accurate to within + 0,5 %.

- FUEL CONSUMPTION
- + 1 % for all apparutus used.
- TEMPERATURES

Intake air + 1°C.

- PRESSURE

Atmospheric pressure ± 0,7 mbar
Air and gas pressure ± 50 mbar
Induction and exhaust pressure and depression ± 0,250 mbar
Pressure of other fluids + 250 mbar.

~;\$

SECTION 2-2 - DEFINITION OF ENGINE

Engines will be equipped only with such auxiliary equipment as is strictly essential to their operation (see table of auxiliary equipment at section 2.6).

3

SECTION 2-3 - PERFORMANCE TEST

The performance test maximum load curve will be plotted from measurements taken at a minimum of five speed settings, one of these settings being the rated speed.

For each setting, the engine should be run for a sufficient time to allow the operating parameters to stabilize.

Part-load data is to recorded at the same pre-selected speeds as was used for the full-load test. The part loads for each speed point are to be calculated at least for 85 %, 70 %, 50 % and 25 % of the full load at the given speed.

During this test, the smoke emission as measured on the Robert BOSCH Scale (or equivalent) shall not exceed 4.5. (Diesel engines only).

No correction factor will be applied and the test results must include air temperature and atmospheric pressure.

SECTION 2-4 - ENDURANCE TEST

- 2.4.1. The endurance test duration is 400 hours, divided into four periods of 100 hours each. At the completion of each period, the engine shall be submitted to a full load performance check.
- 2.4.2. Normal maintenance and adjustment will be permissible after each 100 hour test period.
- 2.4.3. Engine oil and filters may be changed after each 100 hour period.
- 2.4.4. The engine oil temperature is to be measured in the lubrication system. The temperature measurement location shall be specified.
- 2.4.5. The four 100 hour periods which make up the endurance test are to be carried out with the fuel defined in 2.1.5.
- 2.4.6. Each 100-hour period is to comprise ten 10 hour cycles. Each 10 hour cycle will be carried out in accordance with the programme (2.5).

The change from one running condition to another should be accomplished within 15 seconds. If not, it must be reported in the test report.

- Data will be recorded during the last five minutes of the sub-cycles included in the basic 10 hours cycle, with the exception of sub-cycle 5.
 - 2.4.8. No interruptions are permitted during any of the sub-cycles, but the engine may be switched off on completion of any sub-cycle.

At least 5 times during each 100 hour period, the engine will be shut down for a minimum of 8 hours.

The engine must be warmed up prior to resumption of test.

3

SECTION 2-5 - PROGRAM OF 10 HOUR CYCLE

Sub- cycle	% Rated Speed	% Load	Duration in hours		
1	IDLE (1)	. 0	1 2		
2	100	100	2		
3 ~	governed speed (2)	0	1		
4	75	100	1		
5	IDLE (1)100	0 100 4 min 6 min	2		
6	60	100	1/2		
7	IDLE (1)	0	}		
8	governed speed (4)	70 (4)]		
9	Max torque speed	100	2		
10	60	50 (5)	1/2		
, 5	Total				

NOTES:

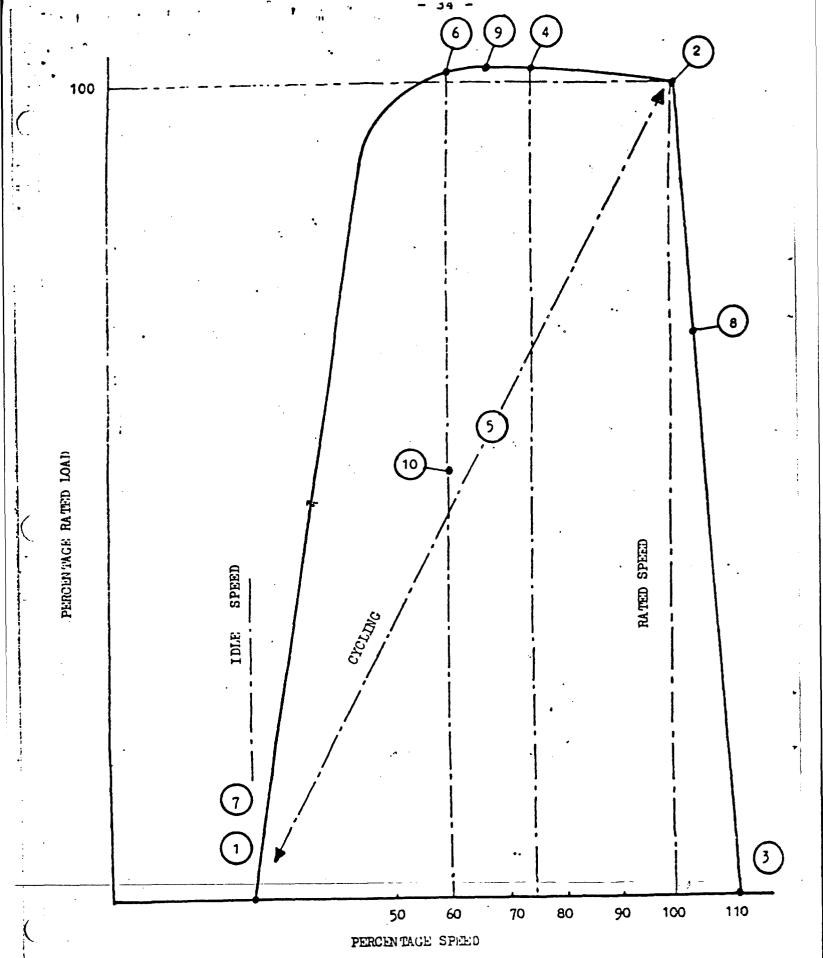
- (1) Deviation from the regulated outlet coolant temperature (96°C
 ± 3°C) is permitted
- (2) The speed shall be that attained with the engine at full throttle and with minimum load (residual brake load)

When the engine is not fitted with a governor, the throttle will be adjusted to attain $110\$ of the rated speed

- (3) The moving of the command is shorter than 3 seconds
- (4) The speed shall be the steady speed of the engine at full throttle and 70 % load.

When the engine is not fitted with a governor the speed will be 103 % of the rated speed

(5) Part loads (70 and 50 %) shall be taken from the initial performance test.



GRAPHICAL PRESENTATION OF 10 HOUR CYCLE

- 34 - \ B-16

SECTION 2-6 - DETAILS OF REQUIRED PRODUCTION AUXILIARY EQUIPMENT

<pre>Inlet system Inlet manifold</pre>	Yes Optional
<pre>Exhaust system Manifold</pre>	Yes Test bench equipment
Fuel feed pump	Yes
Carburettor	Yes (details of adjustment will be specified)
Ignition system Distributor	Yes Yes Yes Yes
Fuel injection equipment Prefilter	Yes or test bench equipment Yes Yes Yes Yes Yes Yes

Liquid cooling equipment Radiator	No Yes Yes
Air cooling equipment Streamlining	Yes Yes Yes
Electrical equipment	If necessary
Supercharging equipment Compressor driven directly or indirectly by the engine and/or exhaust gas	Yes Yes Yes

SECTION 2-7 - INFORMATION TO BE INCLUDED IN TEST REPORT

A complete report covering all the tests, servicing, maintenance, rectification of faults and the condition of the engine at the strip examination including the measurements of the principal wearing arts will be compiled.

The report will also include the following.

- 1. A statement of the build standard of the engine, with drawings and a parts list
- 2. Photographs of the engine from four different views
- 3. Photographs of the test installation at least four different views
- 4. A list of equipment fitted to the engine
- 5. Sample test sheets and a summary with a list of faults and the remedial action taken.
- Full load performance data will be shown in the format indicated.
- A list of failures and corrective actions to overcome them.
- 6. An engine condition report at end of test with photographs of the condition of major parts such as pistons, bearings, valves, camshafts, crankshafts, cylinder bores together with any other components of interest.
- 7. A trend chart of oil consumption and blow-by during the endurance tests.
- 8. Analysis of new and used lubricating oil, the latter to be taken at approximately 100 hours intervals.
- 9. Fuel analysis
- Any other relevant data.

, MC	TEUR GINE	type _			•	rr		LIEU-PLA	CE
1			A PLEINE CH				init.	REFERENC	E
FU!	SSE VO	LUMIQ	UE (15°C)	m²	HUILE OIL GRADI	-		FREIN BRAKE	
AMBIANCE AMBIENT	tO 'pO	*C							
PERFORMANCE A	n M	tr/min · r.p.m mdan							
PERFO	p.m.e m.e.p	kw bar						••	
COMBUSTIBLE	Cs/bsfc Oc	g/kwh mm/c							
СОМВ	qm tf	*C							
HUILE	th ph	°C bar							
EAU WATER	te ts	*c							
	t1 p0-p1	*C m ber							
ADMISSION INLET	t2 p2	*C bar							
\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	t2' p2-p2' qa	*C m ber					·		
TN	เ3	*C							
ECHAPPEMENT EXHAUST		·c-							
<u></u>	fumée amoka ge carro v by	3osch							

SYMBOL DEFINITIONS

ti : température

of

pi : pressure

air or gas i = 0 ambient

= 1 after air filter

= 2 after compressor

= 2' after charge cooler

= 3 turbine inlet

= 4 after turbine

fuel i = f

oil i = 1

water i = e inlet engine

= s outlet engine

q : mass flow i = m fuel per hour

= a air per second

qc : volumetric flow injected per cycle and per cylinder

bsfc : brake specific fuel consomption

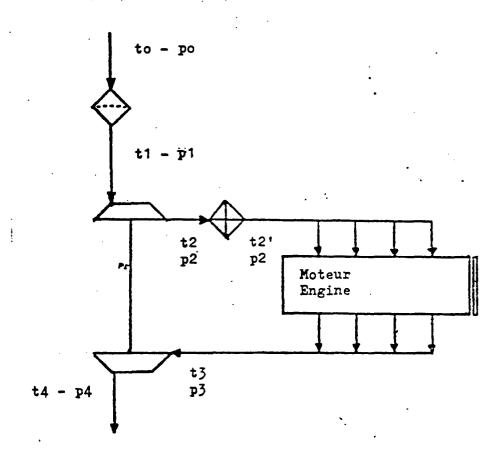
bmep : brake mean effective pressure

n : rotation speed (engine output shaft)

M : torque idem

p : power idem

- SCHEMA DE PRINCIPE DE MOTEUR DIESEL ET A ALLUMAGE COMMANDE
- SCHEMATIC DIAGRAM DIESEL AND SPARK IGNITION ENGINE



APPENDIX C
SAMPLE TEST SHEETS

C-2

57, 57, 73 FRE

	<u>.</u> .	in a company of the c	as many and a second recording to the second of the second	
į				
				•
. 27	L			
% · · · · · · · · · · · · · · · · · · ·) 1000004444 000000 00000 00000 00000 00000 00000 0000	0004 0002 0003 0003 0004 0004	000 000 000 000 000 000 000 000 000 00
98 /	D.	05 F & F		
09704786	MAO 1	HAND FEET OF F	24090044 11:08	40 6 565 00 0 000 00 0 000 00 0 000
	PERFORMANCE 00% LOAD. FRDF	13:18 13:18 13:18 13:18 13:18 13:18 12:02 12:02 12:02 12:02 13:02 13:02 13:02 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03 13:03	222211 1812224 201111 20211 19211 19311 19311 19311	222 223 223 108 108
	Per F	", amoutimoso minorio	124 447 100 100 100 100 100 100 100 100 100 10	₩₩ ₩ ₩₩4
76482		2001 1200 1200 1200 1200 1200 1200 1200	2451 2477 2477 1 18 18 1 19 98 91 1 2 5 88 2 2 7 5 3	22 2 2 34 1 4 1 4 1 4 1 4 1 4 1 4 1 4 1 4 1 4
-		8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8	222 222 222 222 222 222 222 232 232 232	242 229 224 244 121 145
- NUMBER TS	72-0268- 79-5398- 0. IS	22,100 100,42 100,42 100,42 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 100,43 10	10.00	an a
		877 29:22 29:22 29:22 41:0 44:4 32:6 46:0 46:0	2227 2237 2239 2329 2329 2329 2329 2329	233 227 240 117 144
	A CAO	768. 700 133.	0	
TA_	STATE TIES	700505050505050505050505050505050505050	22237	237 225 225 237 238 117 130
LL DAT	LARRY NIEMCH 574-5711 / H KEN RATCLIFF 574-5711 / H C FOR STORY MILAD MEKARI 574-6652	1 10	A	44 N +N4
- 7	ר כי מדר שר איני איני איני איני איני בי איני איני בי איני אינ	77.7.7.7.7.7.7.7.7.7.7.7.7.7.7.7.7.7.7	222 2234 101 27.6 27.7 27.7 27.7 27.7 28.8	22 22 22 22 22 22 22 22 22 22 22 22 22
a TEST _o	NCE ON THE	24600/480/ 04084		31 31 82 01
CENTER	TANDANT PERFORMANCE ENSINE ENSINE THE ELWOOD THE ELWOOD CHANGE THE CHANGE THE	2000 2000 2000 2000 2000 2000 2000 200	2,222 11,122 11,123 12,25 2,25 2,25 2,25 2,25 2,25 2,25 2,2	,
ENT	NE ONOTA OF THE CAME OF THE CA	9/03 88:10 1400 143:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24 123:24	22228 22228 22228 22228 2324 2425 243 243 243 243 243 243 243 243 243 243	2228 217 226 226 111 96
CLOPM	######################################	20.00 20.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00 36.00	N H	
DEVE		8 000 1000 2000 2000 2000 1000 1000 1000	7.6 1.02 1.02 1.13 0.32 7.6 7.6 7.6 7.6 7.6	76 76 74 76 76 76
GNA_	NA TOWN TOWN TOWN TOWN TOWN TOWN TOWN TOWN	200	1 0	
PARCH	THIS TEST IS TO BE USED DETERMINE HOW FIRE RETAR FUEL WILL EFFECT THE FER OF A MILLTARY-ADAPTED EN DURING THE ENGINE IS TO BE USED AND THE ENGINE IS TO BE USED AND THE ENGINE IS TO BE USED AND TO BE US	7500000 14000	25228 25228 25228 25228 25228 25228 25228	622 633 889 869
RESI	HOUSE HOUSE			ու ո աա
COMMAND RESEARCH AND DEVELOPMEN			00000 001 0000 00000 001 0000 00000 001 0000	
E_CO	10 1.			TERS S PUMF
TANK-AUTOMOTIVE	NEW ENGINE SERIAL NUMBER 176482 MODEL DT-466 SPECIAL PROGRAM CODE IN 1 A FIRE RETARDANT LIT IN 1 A COMPRESSION RATIO 16.3 TO ORDER NUMBER CUSTOMEN RAME SPECIAL INSTRUCTIONS	TE MAGUE HORSE POWER ECCONSUMPTION LB ECRITICAL POINTS R AFT CLEAN. R AFT CLEAN. R AFT CLEAN. R AFT CLEAN. R AFT CLEAN. R AFT CLEAN. R AFT CLEAN.	OIL, ENGINE GALLERY OIL, TURBO OUIT FUEL, AFT. FILTERS FUEL, AFT. FILTERS COULT TURBO OF ANTI- TURBO	SUMP GALLERY 30 OUT ENG, FIL
AUTO	GINE MAGERATION ROGRAM CODI ROGRAM CODI RETARDAN COLI RETARDAN ON RATIO DER NSTRUCTION	100 ONSCRIPTION OF COLUMN	NOTINE TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWNS TOWns Towns Towns Towns Towns Towns Towns Towns Towns Towns Towns Towns Towns Towns Towns Towns Towns Towns Towns Towns Towns Towns	ENG. SUMP ENG. GALLER TURBO OUT. . B4 ENG. FI
TANK=	STANE ASSERTANCE CAME VAME	DATE OF CALL O	RANA HEREILLE	
ARMY .T	MENTAL ME	ALGORDON AAAMO	PAPA MMCTTDOO	21 FU
S. A	MANUAL MA	111	0000 0000 0000 0000 0000 0000 0000	88 8 899
	WEWHHOOD IN 1 1	C-3		

		t	-			1	٠.)		. '			——————————————————————————————————————
() X 90																	
į	0000 0186 0186	020 017 141	062 063 063	 000 00	890	690		136 081 082 083	060	085 084	091 086	108	105	106	103		
07/	195-DEG F 203-DEG F 703-DEG F 195-DEG F	97 DEG F 199 DEG F 199ENTRY 3	898 DEG F 978 DEG F 923 DEG F		1009-DEG-F- 934 DEG F	941 DEG F		29.93 H9 -1.22 H20 -2.28 H20 -4.31 H20	8.21 H9	-0.56 H20 0.81 H20	6.12 Hg 2.04 H20	18.5 PSI 1.90 PSI	11.0 PSI 16.4 PSI	67.1 PSI 15.8 PSI	4.2 P		
9-176482==	9229	1113 2000 199	1005	900	11138	985		29.93 -1.23 -8.25	٥.	2.11	27.64	18.8 1.84	19.1	66.9			
⊘ NUMBER®	195 204 204 197	1114 199 199	1087 1087 1087	900 900	1084	776		29.93 -1.24 -6.99	27.31	2.10	23.57	15.6	18.5	66.7	46.5		; i •.
7 SERIAL	1	199	1064	1001	1058	896		29.93 -1.23 -5.68	24.19	1.17	19.57	9.2	17.9	66.8 15.3	•		
DATA		108 199 199	958 1049 1009	996 895	1086	896		29.93 -1.24 -4.57	20.45	0.53	15,65	2.21	17.4	66. 8.0 8.0	4		
5 TEST-CELL	197 204 74 198	1999	952 1044 991	~ ∞∞	1076	976		29.93 -3.63 -8.67	16.56	0.33	12.29	8.6 1.55	17.0	66.8 15.2	=		•
:/ CENTER	196 205 74 197	0.00	926 1010 959	บจจ	1042 985	596		29.93 -1.24 -2.74		0.90	9.03 2.35	21.4	111.1	66.8 15.4	œ		
.3 ELOPMENT	194 203 75 198	90 199 199	898 979 923	9114	1010	938		29.93 -1.24 -2.08	9.24	-0.44	1.43	29.6	11.2	66.9			
2 AND-DEVE	57.9	200 200 200 200	0000	888	100	78		0.09	-0.02	-1.99	-0.23	-1:1	14.8	61.8	•		٠
ESEARCH-	440.0 R	70 193 199	65 55 55 55 55 55 55 55 55 55 55 55 55 5	264 264	64 84	09	÷	29.64 0.02 0.04 0.04	-0.07	-1.91	-0.25	-2.9	14.8	67.2 13.8	=		
A-GNAMMC	0000 0000 0000 0000	1	DEG F	1	DEG F	DEG F		H H H H H H H H H H H H H H H H H H H	HG.	H20 H20	D) HG.	PSI	PSI	PSI	PSI	.	
U.S. ARMY.TANK-AUTOMOTIVE-COMMAND-RESEARCH-AND-DEVELOPMEN	0000	O DYNO, WATER GUTLET 7 REF. BATH 1 REF. BATH (KEY IN)	061 EXH. PORT #1 062 EXH. PORT #2 063 EXH. PORT #3	EXH. PORT #4 EXH. PORT #5 EXH. PORT #6	067 EXH. B4 TURBO FRONT 068 EXH. B4 TURBO REAR	069 EXH. AFTER TURBO	·	136 BAROMETRIC PRESS. 081 AIR, CELL DEPRESSION 082 AIR, B4 TURBO TOTAL 083 AIR, B4 TURBO STATIC		085 BLOW BY, CRANKCASE 084 BLOW BY, CAL. ORIFICE	091 EXH.B4 TURBO COMBINED)	108 FUEL, AFT, FILTERS 101 FUELSPILL INJ & PUMP	104 COOLANT, ENG. INLET	106 WATER, TOWER INLET 107 WATER, DYND INLET	į		

		•		* *			0	\$ 3
1.32	1.6	Can						
90	REPUL'S	(2)	000444 000444	000 0003 0003 1003 1003	000 000 000 011 0110 015	069 086 0001 0003 004	000 000 008	010
09/04/86	PEZFORMANCE IN % OF LOA. INOO A 1600 F		24.3 LB-FT 14.3 LB-FT 14.1 BHP 15.15 LB-FT 15.15 BFF 15.15 BFF	4 W4000	221 DEG F 233 DEG F 233 DEG F 120 DEG F 191 DEG F	92 DEG 93 DEG 93 DEG 99 DEG	233 DEG F 221 DEG F 233 DEG F	84 DEG F 120 DEG F 130 DEG F
76482	PE2F. IN % TROO	25%	15:46 1597 101 101 15:8 50 514	2.6	2117 2117 2717 196	92 92 93 93 117	217 211	84 117 105
SERIAL-NUMBER 1-1764 82	5398 1 S	50%	15:37 1600 200 27:50 0.451	64.7 3.32 3.455 -1.32 39.12	2223 2223 2118 2118 1919	ነሰለ ሌሌሌለ	223 215 218	84 116 105
SERIAL	TOGRAM TOME 77 TOME 77 TOME 77	70%	15:21 1597 287 35:4	N	2227 7223 711 19:1	2.05 2.05 93 94 149	227 217 223	84 117 106
DATA	LARRY NIEMC 574-5711 / 574-5711 / KEN RATCLIF 574-5711-7 574-6652	0 79	15:08 348 1058 1058 0 44:1	2 vr. a. 2	2229 2227 227 117 22.5	2,83	229 218 227	83 117 108
EST CELL	8 8 1111	160%	2002 2002 2002 2002 2002	126.8 11:09 -0:20 36.9	219 2230 2230 118 20:0	93 3.30 94 178	230 219 229	85 111 111
CENTER TEST	TO TORMANCE FORMANCE FORMANCE FORM FEEL WOOD FEEL WOOD FORMANCE THE OPERATE		14:24 14:24 14:24 0.13:55 0.52:55	e4 + 1 + 1 + 2 }	215 215 19.0 201 201 201	9440 9450 945 112	215 210 210	88 121 106
LOPMENT	BE USED THE PERSON OF THE PERS	ฬ~୧	13:59 1399 188 188 50 23:1	0 0040	2112 213 26:0	0.86 0.88 92 93 122	219 211	88 121 106
AND-DEVE	NET IS TO	1111	13:43 1399 266 70 29:3	86.0 -2.10 -1.58 34.7	223 223 120 16.2 19.2	1.33	223 214 218	1020
RESEARCH	THIS TEST IS TO BE USED TO DETERMINE—HOW FIRE RETARDANT FUEL WILL EFFECT THE PERFORMANCE OF A MILITARY-ADAPTED ENGINE DURING HOURING HOUSE TEST THE ENGINE IS TO BE THE ELWOOD SYSTEM ECORDING DATA THE CONDITION.	1400 85% 111 10 9/03	13:35 1399 321 33:6 0 39:6	103.8 -2.19 -6.87 34.2	215 224 221 14.3 18.3	1.65 1.65 92 92 148	224 215 221	87 120 108
COMMAND		// July 100	HENERAL BARANA B	1 1	0000 00000 00000 00000 00000		DEG F DEG F DEG F	S DEG F DEG F MP DEGF
ARMY.TANK-AUTOMOTIVE-COMMAND-RESEARCH AND-DEVELOPMENT	NEW ENGINE SERIAL NUMBER 176482 MODEL D1-466 MCDEL SPECIAL PROGRAM CODE I.M. TIAL CELL ASSIGNMENT I COMPRESSION RATIO 16.3 TO	11 -	30 TIME 13 RPM 13 BRAKE HORSE POWER 42 FUEL CONSUMPTION 45 BFFC.	4 00000 4 00000	007 OIL.ENGINE GALLERY 006 OIL.SUMP 008 OIL.TURBO OUT 011 FUEL.AFT.FILTERS 008 FUEL.AFT.FILTERS 015 COCLANT.ENG.QUT	62 EXH. AFT. TURBO STAT 86 EXH. AFT. TURBO STAT 02 AIR. B4 CLEANER 03 AIR. AFT. CLEANER 04 AIR. AFT. TURBO	006 OIL.ENG.SUMP 007 OIL.ENG.GALLERY 008 OIL.TURBO OUT	010 FUEL, B4 ENG, FILTERS I 011 FUEL, AFT, FILTERS I 012 FUELSP: LL INJ & PUMP
\$ 7	SECULIARIO DE LA COCO DEL LA COCO DE LA COCO DE LA COCO DEL			- 0000-	000000	00 0000	000	

34							. ! !								
(1)	0015	020 017 141	061 062 063 064	065 065		690		136 081 082 083	060	085 084	091 086	108	105	106	103
20.09/04/86	200 DEG F 200 DEG F 78 DEG F 193 DEG F	106 DEG F 199 DEG F 199ENTRY 3	962 DEG F 1055 DEG F 1003 DEG F	004 DEG 900 DEG	1034 DEG F	990 DEG F		29.93 H9 -1.24 H20 -3.46 H20 -8.30 H20	08	0.09 H20 1.34 H20	11.26 H9 5.13 H20	1.3 P	17.1 PSI	66.9 PSI 15.7 PSI	40.0 PSI
76482	196 200 79 196	89 199 199	489 497 476 476	აფო	506	474		29.93 -1.23 -2.17	~	-2.02 -0.14	3.27	27.5	16.8	67.1	41.1
NUMBER:-1	197 202 78 197	94 199 199	648 685 652	596	703	652		29.93 -2.32 922	4	-1.32 0.10	4.55	24.7	16.8	67.0	39.1
SERIAL.	193 201 76 196	96 199 199	783 847 805	793	875 813	908		29.93 -1.25 -2.50	•	-0.86 0.51	2.05	19.1	16.8	67.0	37.9
DATA	193 202 78 197	200 200 199	986 945 952 952	ກຜດ	974	006		29.93 -1.22 -2.57		-0.62	7.19	22.5	16.7	67.1 15.8	37.4
75, TEST CELL	196 203 77 198	97 199 199	936 1018 968	OV T	1053	973		29.93 -1.23 -2.77	1:0	-0.20	8. 9. 30.	20.0	10.8	67.0	ં
CENTÉR TE	204 204 80 199	85 199 199	440 445 445	423 403 603	474	440		29.93 -1.23 -1.93	. 8	-2.30	2.47 0.45	19.0	16.9	67.1 15.8	•
/ELOPMENT_C	201 201 78 197	89 199 199	607 644 611	606 558 558	658	614		29.93 -1.23 -2.06	, vi	-1.98	3.38	26.0	16.9	67.0	•
/ Z	194 201 77 195	200 199	733 790 743	440	814	759		29.93 -1.24 -2.10	4.71	-1.58	1.33	16.2	16.3	67.1 15.8	
SEARCH-	194 203 277 197	200 199	820 886 836	835 768	918 849	856		29.93 -1.23	4 4	-0.87	5.26	14.3	16.4	67.0	4
IMMAND RE	0000	•	1	1	DEG F	G		7500. 720.		H20 H20	D) HG. H20	PSI PSI	PSI	PSI	1 O
U S. ARMYTANK-AUTOMOTIVE.COMMAND.RESEARCH.AND.DEVI	015 COOLANT, ENG. INLET 016 COOLANT, ENG. OUTLET 018 MATER, TOWER OILL FT	O DVNO, WATER OUTLET REF BATH (KEY IN)	EXH. PORT #1 S EXH. PORT #2 S EXH. PORT #2	*** 5.54	EXH. B4. TURBO FRONT.	EXH. AFTER TURBO		O 081 AIR CELL DEPRESSION 082 AIR 84 TURBO TOTAL	AIR.B	085 BLOW BY, CRANKCASE	EXH. B	108 FUEL, AFT, FILTERS 101 FUELSPILL INJ & PUMP	104 COOLANT, ENG. INLET	OG WATER, TOWER IN	OIL, ENG. GALLERY
	1	ĺ		:	ļ		ļ	4	Ì	;	1				:

ဏ္ဏ်
35
ŏ
-
٠
8
3
09/04/8
φ
Z
6482
76.
=
å
BEA
5
Ž
₹
ERI
S
i
ATA
ă
4
TEST-CELL
1
S
_
Ë
Ę
CENT
۳
MENT
P. O.
EVEL
Ë
Ş
₹
춍
Œ
S
R
₫
Æ
ÄΖ
휺
币
DIIV
Ž
ĝ
뒬
J
Ž
1
ξ
ARI
S
7
,

FRF FERFORMANCE TEST IN 40 CE LCAD 1800 R.F.M.	4.8hul						
	131	000000044 00000004	00000 00000 000000	000 000 000 011 0115 069 086	0000 0002 0004 0004	006 007 008	010 011 012
	* 7	1799 RPM 106 LB-FT 1935 LB/HR 0.537 BSFC 34.3 BMEP	-2.53 H20 -1.68 H3 -1.54 H20 44.4 FSI	213 DEG F 219 DEG F 122 DEG F 122 PSI 198 DEG F 198 DEG F 198 DEG F 198 DEG F	90 DEG F 91 DEG F 120 DEG F	219 DEG F 213 DEG F 214 DEG F	84 DEG F 122 DEG F 130 DEG F
	50% 23 9/03 17:00	1800 215 73 33.7 0.457	-2.70 -0.86 -0.86 42.8	2225 2225 1222 1221 1225 196 2.40	91 91 139	225 216 221	84 132 131
	.P. H 70% 22 9/03 16:46		-2.91 -0.61 41.3	222 222 222 1227 12.72 13.39 3.39	163	229 219 227	133
	1800 P.1 85% 21 9/03 16:31	363 363 124 52.2 0.420	-3.23 11.87 -0.16 40.6	2220 10221 10220 1930 1930 1930 1930 1930 1930 1930 193	92 92 181	231 220 230	84 138 138
		RPM LB/HR BHP B/HR B/HR BMEP	DEG F N H20 H20 H20 H20	7 DEG F DEG F DEG F DEG F T20 H20	00000 00000 00000 00000	DEG F DEG F DEG E	ERS DEG F DEG F PUMP DEGF
	31	HORSE POWER	CRITICAL POINTS 003 AIR AFT CLEAN. 082 AIR AFT CLEAN. 090 AIR AFT TURBO 090 AIR AFT. 103 OIL, ENGINE GALLERY	007 OIL, ENGINE GALLERY 006 OIL, SUMP 018 FUEL, AFT, FILTERS 108 FUEL, AFT, FILTERS 015 COOLANT, ENG. OUT 065 EXH, AFT, TURBO STAT	001 AIR.B4 CLEANER 002 AIR.B4 CLEANER 003 AIR.AFT.CLEANER 004 AIR.AFT.TURBO	006 DIL, ENG. SUMP 007 DIL, ENG. GALLERY 008 DIL, TURBO DUT	010 FUEL, B4 ENG.FILTERS 011 FUEL SPILL INJ & PU

ŧ,

:

65.50											
		P ₁ ,									
-077.047.86											
BERT-1-40											
SEKIAL-NUMBERT1-/648/											
DEG -F 018 DEG F 019 DEG F 019	020 017 141	0622 0630 0630 0630 0630 0630 0630		690	136 081 082 083	060	085 084	091 086	101	105	106
2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	150 17 17 13 13 13 13 13 13 13 13 13 13 13 13 13	00000000000000000000000000000000000000	DEG F	DEG F	2000 1220 1220 1220	ъ,	H20 H20	H30 H20	PSI PSI	PSI	100
201 E	92 DEG F 199 DEG F 199ENTRY	5133 5133 5133 5133 5133 5133 5133 5133	542 m	509 DI	29.93 -2.53 HH H 5.53 HH		-1.54 H	4.26 H 1.45 H	12.2 PS	-10.6 PE	67.1 PSI
201 201 197	97 198 199	687 693 693 697 641	753	669	29.93 -1.24 -2.70 -6.12	.: •0	-0.86 0.46	2.40	12.5 2.18	17.6	66.9
196 202 78 196	102 199 199	823 836 846 821 757	918 856	835	29.93 -1.24 -2.99	•	-0.61 0.80	3.39	12.7	17.2	66.9
193 202 78 197	105 198 199	893 978 936 922 821	1012	922	29.93 -1.24 -3.23 -7.56	11.87	-0.16	9.83 4.34	10.7	17.1	66.8 15.8
0000 0000 0000 0000 0000	DEG F DEG F DEG F	000000	EG F	DEG F	2000. 1200. 1200.	HG.	H20 H20	D)HG. H20	PSI	PSI	PSI
INCET I).		FRONT D		RESSION TOTAL STATIC		ASE IFICE	COMBINED	SS PUMP	EET	
COOLANT.ENG.IN COOLANT.ENG.OU WATER.TOWER WATER.TOWER OU	OUT EY	##### 4004D0	TURBO FI	TURBO	TRIC PRES L DEPRES TURBO TO TURBO S	TURBO	CRANKCASE CAL.ORIFI	IRBO (CC	FILTERS INJ & F	COOL ANT. ENG. INL	WATER, DYNO IN ET
015 COOLANT. ENG. INLET DEG F 202 018 WATER TOWER OUTLET DEG F 78 019 WATER, TOWER OUTLET DEG F 197	DYNO, WATER REF. BATH REF. BATH (K	PORT PORT PORT PORT	84	. AFTER	BAROMETRI AIR, CELL AIR, B4 TU AIR, B4 TU	AIR.AFT.T	BY	. AFT. TURBO	FUELSPILL FUELSPILL	ANT	R. DYN
######################################	ZLL	MAKE THE TENT THE TEN	EXH	EXH.	REAL	4IR	BLOW BLOW	EXH		90	ĘĘ

3	58% 755 IN GOB FRF 400 TEST HR=400	11 18/86 COMPLETE 11/18/86	
LoAb 176482			006 007 008 008 011 012
50% SERIAL NUMBER	OGRAM IS AKA TO	11.194 12.198 12.198 12.198 19.300 RPM 19.300 RPF 10.300 RPF 10.30	233 DEG F 223 DEG F 231 DEG F 121 DEG F 138 DEG F
74.3	C FOR THIS PR LARRY NIEMCH 574-5711 / H KEN RATCLIFF 574-5711 / H C FOR TECHNIC MILAD MECHNIC 574-6652	1111 23391 2411:22 23991 23991 2500 2500 2500 2500 2500 2500 2500 250	231 222 222 228 121 140
页	2 2 11111	1111 122 12112 12112 12112 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114 12114	222 229 225 121 142 142
Sunfactant en center cent	TO BE USED TO FIRE RETARDANT FIRE PERFORMANCE ANDAPTED ENGINE NET IN	1111 12002 12002 12002 12002 12002 1111 12002 1112 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 12002 10002 10002 10002 10002 10002 10002 10002 10002 10002 10002 10002 10002 10002 10002 10002 10002 10002 10002 10002 10002 10002 10002 10002 10002 10002 10002 10002 10002 10002 10002 10002 100	227 218 223 223 122 136
P.	REE USE THE FEE TO STANCE TO STANCE	0 11	224 217 219 219 121 123
SS AND DEVEL	TEST IS TO THE HOW FIND TO THE CONDITION TO THE CONDITION TO THE CONDING THE CONDITION TO T	101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.189 101.18	222 214 215 215 118 104
H 2 O RESEARCH	THIS DETERMINE DETERMINE DETERMINE THE WILL THE THE SYSTEM NO.	2 1.101 1.01 1.04 1.04 1.05 1.05 1.05 1.05 1.05 1.05 1.05 1.05	212 212 212 113 100
COMMAND		BAHBAHAR BAH	7 DEC 7 T DEC 60 T T T T T T T T T T T T T T T T T T
$\Delta F_2 = 5.7$ s army tank-automotive c	NEW ENGINE RIAL NUMBER 176482—— DEL DT-466 ECIAL FROGRAM CODE ITIAL CELL ASSIGNMENT I MPRESSIGN RATIO-16.3-TC STOMER NAME	131 DATE 130 FPM 131 PAME 142 PARKELE CONSUMPTION 145 BSFC 145 BSFC 144 BREP 145 BSFC 145 BSFC 146 BSFC 147 BSFC 147 BSFC 148 BSFC 148 BSFC 148 BSFC 148 BSFC 148 BSFC 168 BSF	10 0 0 10 N

ļ		· [\	- 1	_	· •	İ	J	·•		-	į	 	-	-	_ 	
11/18/86 12:56	SAS FRF (Low)															
11 1/6482	000 000 000 000 000 000 000 000 000 00	a Na	141	0000 0000 0000 0000 0000 0000 0000 0000 0000	990	067	690		136 081 082 083	060	085	091 086	108 101	104 105	105	103
SENTHE MOLIDEN.	197 DEG F 203 DEG F 49 DEG F		ENTRY	825 DEG F 795 DEG F 814 DEG F		835-DEG F	751 DEG F		29.98 Hg -1.14 H20 -5.08 H20 -15.32 H20	12.43 Hs	-0.86 H20 -0.56-H20	16.62 Hg 7.50 H20	18.9 PSI 1.09 PSI	9.0 PSI 17.1 PSI	14.6 PSI	49.1 PSI
1	199 204 49	7287	0 - 744	793 765 781	766 681	835	733		29.98 -1.12 -4.45 -12.50	10.19	-0.78	13.81	16.7	9.3	14.4	48.9
LESI CELL		7289	0	726 726 740	727 656	802	710		29.98 :- -1.14 -3.51	•	-1.03	10.94	12.7	9.5	68.8	48.3
	199 204 49	7289	0 .	7770 7007 7009 7009	, 705 633	784	698	i 1	29.98 -1.14 -3.11		-1.36	3.33	13.2	15.9	. 68.8 14.8	47.1
DEVELCTMENT	199 204 50	7289	0	955 672 675 675	622	744	999		29.98 -1.11 -2.76 -6.28	. 0	-1.46	2.21	15.2 0.97	9.8 5.5	-68.7-	45.4
HIND DEVEL	199 203 51	7288 194	0	9999 7989 0000 0000	579	698	628		29.98 -1.14 -2.43	.47	-1.82	4.84	30.5	10.1	15.1	43.5
RESERVED TO	199 204 51	മെലര		19623 1993 1993 1993 1993 1993 1993 1993 19	V4	589	594		29.98 -1.13 -2.43	<u>س</u>	-1.77	3.61	30.8 1.66	10.3	15.1	39.4
S DESERVED	1 1	n Inn	00	2000 3000 2000 711111	ည်တ	DEG F	DEG F		2000. 2220. 2220.	HG.	H20 H20	D) HG. H20	PsI PsI	PSI	PSI	PSI
U S ARMY TANK-AUTOMOTIVE CO	015 COOLANT, ENG. INLET	9 WATER, TOWER OUTLE O DYNO, WATER OUTLE 7 REF RATH	REF. BATH	061 EXH, PORT #1 063 EXH, PORT #2 064 EXH, PORT #4	EXH. PORT	067 EXH, B4 TURBO FRONT 068-EXH, B4-TURBO-REAR	9 EXH. AFTER TUR		136 BAROMETRIC PRESSION 081 AIR CELL DEPRESSION 082 AIR B4 TURBO TOTAL 083 AIR B4 TURBO STATIC	AIR, AFT, TURBO	085 BLOW BY, CRANKCASE 084 BLOW BY; CAL: ORIFICE	091 EXH. B4 TURBO(COMBINED)H 086 EXH. AFT. TURBO STATIC	108 FUEL, AFT, FILTERS 101 FUELSPILL INJ & PUMP		105 WATER, TOWER INLET	103 DIL, ENG. GALLERY

:				
20.	(h)			- Andrew Mayor in a series suppress and the series of the
163	3080 2000	2000 0000 0000 0000 0000 0000 0000 000	006 007 008	010
09/04/36	PERFORMANCE VERCENT LCA. 2000 2200 24	227 DEG F 238 DEG F 239 DEG F 238 DE	238 DEG F 227 DEG F 239 DEG F	87 DEG F 121 DEG F 148 DEG F
176482	000	2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2	224 217 220	90 127 147
NUMBER: 1	0 25 15 8 8 8 1 15 8 9 8	10, 10, 10, 10, 10, 10, 10, 10, 10, 10,	229 221 227	126 150
SERIAL	TOGRAM I TOME 772 TOME 1779	7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.001 7.	233 223 232	86 124 150
рата	FOR THIS P	22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22.25 22	236 225 236	88 124 147
TEST CELL	0 0	2.2000 2.2000 2.2000 2.2000 2.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000 3.2000	222 216 217	85 129 145
CENTER TE	SED TO ETARDANT PERFORMANCE DENGINE NCE TEST. O BE RUN IN H THE ELWOOD A. THE ELWOOD O CHANGE THE	222 222 232 232 232 232 232 232 232 232	228 220 225	124 138
ENT	THE STATE OF THE S	881 8.9 ELO4	231 222 229	85 124 140
AND DEVELOPM	S TEST IS TO BE USE IN WILL EFFECT THE FORM IN A NATO-ADAPTED TO THE FORM IN A NATO-ADAPTED TO THE FORM IN ENGINE IS TO THE FORM IN RECONDING DATA-TEMPLE HOVE TO THE FORM IN THE WILL HAVE TO THE FORM IN TO THE FO	2220.18.1 2.01 27220.18.1 8.00.4 2222.4 8.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00.2 1.00	233 222 232	85 122 136
RESEARCH	#FBFR #8888 111	2000 000 000 000 000 000 000 000 000 00	102 102 87	121 91
COMMAND F	·	HA:: DE C F F F F F F F F F F F F F F F F F F	DEG F DEG F DEG F	DEG F DEG F DEGF
/ U S ARMY TANK-ALITOMOTIVE C	W ENGINE 176482 L NUMBER 176482 DT-466 AND FOLE FROM AND FUEL ASSIGNMENT SECOND FOR AND FOLE	131 DATE 130 TIME 140 BRAKGUE 142 FUEL 145 BREFC 145 BREFC 145 BREFC 146 BREFC 167 BREFC 168 BLOW BY: CLE 085 BLOW BY: CLE 085 BLOW BY: CRE 168 BLOW BY: CRE 168 BLOW BY: CRE 169 BLOW BY: CRE 169 BLOW BY: CRE 160 BREFC 160 BREF	005 DIL.ENG.SUMP 007 DIL.ENG.GALLERY 008 DIL.TURBO DUT	010 FUEL, B4 ENG. FILTERS 011 FUEL, AFT. FILTERS 012 FUELSPILL INJ & FUMP
	* ***		1 1	1

	-		-					-		1	,	,	
				1							7		
(4)		020 017 141	06.1 06.2 06.3 06.5 06.5	830	690	136 081 082 083	060	085 084	. 091 086	108	104	105	103
3./	95 DEG 03 DEG 76 DEG 97 DEG	DE S DE S PE S PE S PE S PE S PE S PE S PE S P	936 DEG F 1018 DEG F 985 DEG F 978 DEG F 882 DEG F		930 DEG F	29.72 Hg -1.20 H20 -5.87 H20 -16.37 H20	20.89 H9	0.65 H20 1.65 H20	19.55 Hg	15.4 PSI 1.85 PSI	18.3 PSI	66.9 PSI 15.4 PSI	46.3 PSI
3.3 176482	199 203 75 199	198 200 200	552 522 571 711 711	507 558	263	29.72 -1.21 -3.21 -7.85	3.33	-1.13	6.80 2.85	2.09	-10.1 17.8	66.9 15.3	47.9
3.2. NUMBERL	197 203 76 199	199	747 747 745 745 746	798	733	29.72 -1.20 -3.73	8.09	-0.33	10.01	10.7	19.1-	66.8 15.5	47.0
3/	197 204 75 198	199	838 911 674 877 877	941	820	29.72 -1.22 -4.32 11.44		0.13	13.34	2.47	19.1	15.4	46.1
3c.	195 203 75 196	106 198 200	916 997 952 950 950	1026	-	29.72 -1.21 -4.90		0.72	16.06	10.2	10.1	15.9	ព
2.1 TEST CELL	200 204 200 200	89 198 200	500 500 500 500 500 500 500 500 500 500	576 552	((1)	29.72 -1.21 -2.83 -6.50	2.57	-1.23	5.53	8.3	10.3	66.9 15.3	46.9
2.8 Center te	199 204 75 198	96 198 200	711	786	723	 29.72 -1.21 -3.19 -7.68	œ	-0.47	8.09 3.49	2.45	10.3	15.2	ທໍ
L'H	197 204 197	99 198 200	828 8928 8534 8547	0 (100)	(n)	29.72 -1.22 -3.59	11.26	0.12	10.92	2.28	10.3		ທໍ
2 % J	202 202 194 196	102 198 200	988 988 987 986 936	1021) 🙀	29.72 -1.21 -3.97	7.4	0.29	13.18	2.26	10.2	15.3	4
SEARCH.P	103 722 72	76 199 199	000000 000000	103	94	29.93 -0.01 0.18		-2.00	-0.24	1.50	11.1	61.6	0
COMMAND RESEARCH	DEG F	DEG F DEG F DEG F	200000 200000 200000000000000000000000		9	2000 2000 2000 2000 2000 2000 2000 200	Э	H20 H20	D7HG	PSI	ISd	PSI	PSI
U S. ARMY. TANK-AUTOMOTIVE CO	015 COOLANT, ENG. INLET 016 COOLANT, ENG. OUTLET 018 WATER, TOWER OUTLET 019 WATER, TOWER OUTLET	WATER DUTLET BATH BATH (KEY IN)	2 EXH. PORT #1 2 EXH. PORT #2 3 EXH. PORT #4 4 EXH. PORT #4 5 EXH. PORT #5	EXH. B4 TURBO FRONT	9 EXH.AFTER TURBO	136-BAROMETRIC-PRESS: 081 AIR.CELL DEPRESSION 082 AIR.B4 TURBO TOTAL	90 AIR, AFT, TURBO	085 BLOW BY, CRANKCASE 084 BLOW BY, CAL, ORIFICE	091-EXH.B4-TURBO(COMBINED)	108 FUEL: AFT, FILTERS	104 COOLANT, ENG. INLET	6 WATER, TOWER INLE	03 01L,

4

>

t.:*	. •		,	,		ļ	. ,				1 1	
09/04/86 16:05		7537	, , , , , , , , , , , , , , , , , , ,	SPEED CHECK	(5)	756						
		ERFORMANIE	KOA	i i	9	131 130 113	0844 0823 0823	144 000 000 000 100 000 030 030	000 000 011 000 065 065	000 000 004 004	006 007 008	010 011 012
SERIAL NUMBER: 176482	·	DERK	PERCENT 2400 210		33	9/04 MM/DD 9/04 MM/DD 15:33 HH:MM 2895 RPM	40 LB-FT 22 BHP 28.2 LB/HR 1.011 BSFC	0 00000 0 00000	2222 22333 22333 24192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 20192 2	91 DEG F 92 DEG F 93 DEG F 163 DEG F	233 DEG F 225 DEG F 230 DEG F	86 DEG F 119 DEG F 135 DEG F
SERIAL N					25%	9/04 15:30 2598	33.2 0.706	30.7 92.21 15.83 15.83	2222 2221 2221 2219 2019 2019 2019 2019		231 222 227	85 119 134
DATA					20%	9/04 14:45 2597	186 91 51,2 0,556	60.1 11.89 10.42 47.9	2224 22355 22355 22.9 22.9 22.9 20.8	1922	235 224 233	83 117 134
TEST CELL DATA			·		}	9/04 14:23 2600	~ 0	w 7 <u>m</u> 01	227 240 240 238 2117 2116 11.09	92 92 91 227	240 227 238	83 117 138
CENTER		:			l	9 38 14:00 2598	317 156 77.2 0.492	102.5 23.26 23.26 46.9	222 242 243 20 117 20 1953 1953	91 91 254	242 229 243	83 117 140
DEVELOPMENT					7,52	ÖNÖM	100 45 30.4 0.665	32.3 24.4 1.27 2.3 4.8 3.3	18.2222 18.2222 19.88 19.88 19.88 19.88	911 90 146	228 220 224	84 120 137
AND DEVE					20%	9/04 12:52 2399	(A - 4010)	T	222 2333 1111 18119 1983 760 760 553	0007	233 224 231	119
RESEARCH						9/04 12:18 2400	279 127 60.4 0.473	90.2 87 15.28 15.08 46.8	225 236 236 235 14.8 195 8.88	88 88 87 207	235 225 235	85 120 142
COMMAND					2410	HH: DEAD READ READ	LB/HR LB/HR B/HP-HR		DEG F DEG F DEG F DEG SI PEG SI PEG SI	0000 0000 0000 0000	DEG F DEG F DEG F	S DEG F DEG F MP DEGF
U S ARMY TANK-AUTOMOTIVE						131 130 113	H 120 TORQUE L 143 BRAKE HORSE POWER 142 FUEL CONSUMPTION 145 BSFC		007 OIL, ENGINE GALLERY 006 OIL, SUMP 008 OIL, TURBO OUT 008 FUEL, AFT, FILTERS 108 FUEL, AFT, FILTERS 015 COOLANT, ENG. OUT 069 EXH, AFT, TURBO STAT.	001 AIR, AMBIENT 002 AIR, B4 CLEANER 003 AIR, AFT. CLEANER 004 AIR, AFT. TURBO	889 GIL; ENG: SALLERY 008 GIL, TURBO GUT	010 FUEL, BFT. FILTERS 011 FUEL, AFT. FILTERS 012 FUELSPILL INJ & PUMP

ي و	•	٠ و	•	₹.		- <u>.</u>	•	•	t.	•	. .	ţ	į	Le .	Ψ,	41
09/04/86 16:06																
	20000	020 017 141	062 063 063	\$990 \$990	0 6 7	690		082 083 083	060	085 084	091 086	101	1005	105	103	
42 NUMBER: 176482	200 DEG F 205 DEG F 117 DEG F	89 DEG F 199 DEG F 200ENTRY 3	632 DEG F 650 DEG F 632 DEG F 637 DEG F		DEG	602 DEG F		29.72 H9 -1.20 H20 -4.63 H20 -12.14 H20	5.54 H9	-1.23 H20 -0.02 H20	11.00 Hg 5.16 H20	24.3 PSI 2.20 PSI	19.9 PSI	66.9 PSI 15.5 PSI	49.3 PSI	
4/ SERIAL	203 203 1590	199	643 678 660	550	627	633		29.72 -1.20 -4.21 -11.16	5.83	-1.10	10.26	22.9	18.9	15.4	48.5	
46 DATA	203 203 223	199	785 843 813 813	736	847	778		29.72 -1.21 -5.27 -13.85	11.89	-0.42	14.83	22.9	18.9	14.9	47.9	
37 FEST. CELL	203 203 278 197	103	888 980 928	ってい	992	876		29.72 -1.20 -6.22 -16.97	18.00	0.02	19.09	21.6	18.9	66.8 14.6	47.4	
38 CENTER TEST	203 78 195	106 198 200	962 1046 1007	200	1058	942		29.72 -1.21 -7.11 -19.59	7	0.48	13.91	20.3	9.8	66.9 14.8	46.9	
36 37 DEVELOPMENT	199 204 78 199	91 198 200	595 630 620	554	651	595		29.72 -1.19 -3.68 -9.36	4.44	-1.27	3.92	18.8	9.8	66.9 15.2	48.3	
36 AND DEVE	198 204 77 198	99 198 200	753 809 791	712	841	760		29.72 -1.21 -4.39	10.15	-0.41	12.33	18.3	9.8	67.0 15.0	47.4	
35 RESEARCH.	203	102 198 200	837 929 9029	900 810	964	861		29.72 -1.21 -5.28 -13.87	15.89	0.08	16.45 8.88	14.8	18.2	66.8 15.2	46.8	
COMBEND	0000 0000 0000 0000 0000 0000	DEG F	DEG 7	1	DEG F	DEG F		1200 1200 1200 1200 1200 1200 1200 1200		H20 H20	EDTHG. C H20	PSI PSI	PSI	PSI	PSI	. ,
35 U.S. ARMY TANK-AUTOMOTIVE COMMAND RESEARCH	015 COOLANT, ENG. INLET 016 COOLANT, ENG. OUTLET 019 WATER, TOWER OUTLET	O DYNO WATER C 7 REF BATH 1 REF BATH (KE	1 - EXH. PORT #1 2 EXH. PORT #2 3 EXH. PORT #3	EXH. PORT EXH. PORT	067 EXH. B4 TURBO FRONT	069 EXH.AFTER TURBO	C	The state of the s	AIR. AFT. TURBO.	085 BLOW BY, CRANKCASE 084 BLOW BY, CAL, ORIFICE	091 EXH. B4 TURBOICOMBINED OB6 EXH. AFT. TURBO STATIC	108 FUEL, AFT, FILTERS 101 FUELSPILL INJ & PUMP	104 COOLANT, ENG. INLET	م ه	6	

			<u>~</u>			<u></u>	<u> </u>	-	J.	٠.			ر
3:27	Seriaxe					:			63				•
86 15						٠,							
11/04/1	7 LOAD 100% - HOV R. FUEL		131 130 113	0441 442 443 443 443 443	003	085 103 007	0000	015 069 086	0000 0000 1000 4000	900	800	0100011	
22 thre 7	PEPLENT FEST, 2600 ON F.I	C		S LBTF 1 S LBTR S BSFC		PS10			7 DEG F 7 DEG F 7 DEG F 8 DEG F	8 DEG F DEG F	9 DEG F	2 DEG F 9 DEG F	
K. 1764			11	316 156 80.6 0.515	-10	404	238 239 17.9	14.	236	225	239	122 139	
S 7	15 72-0268 79-5398 F0, 15			0.00 0.00 0.00	o.	-2:32 -1:1	109 109 109	0.41	777	888 888	7	1099	
SERIAL	PROGRAM JCHAKE 777 HOME 777 LIFF		HOMO	376 100 44 0.438 121		36.2	2229 1185 29:38	~ 0 •	732 79 149	229	225	118 103	
рата	POC FOR THIS PROGRAM 574-5711 / HOME 7 KEN RATCLIFF 574-5711 / HOME 7 574-5711 / HOME 7 FOC FOR TECHNICAL IN MILAS TECHNICAL IN 574-6652		11/03 15:20 15:20	63.2 122 62.822 0.433 130.4	-3.80 42	10.96 -0.94 40.5	233 1233 2413 2413	3 919 919 919 919	81 79 170	233 221	231	120 120 106	;
TEST CELL				623 62.8 0.433 136.8	80	15.08 -0.54 2228	234 233 121 16.6	195 967 5.20	81 78 193	23 4	233	121 123	
CENTER TE	SED TO ETARDANT PERFORMANCE DE ENGINE DO ENGINE O BE RUN IN H THE ELWOOD O CHANGE THE ACH OPERAT	60	108 11/03 14:50 2001	425 161 71.0 0.438 137.5		19.35 -0.24 22.8 224	236 236 124 12.9	194 966 7.24	81 79 79 213	236 224	236	124 138	
DEVELOPMENT	ANTERNATION OF THE CONTRACT OF		11/03 14:32 2201	77.6 0.452 132.3		22:58 0.03 67:74 22:53	2337 1224 12.44	-0	79 76 77 231	237 225	238	124 124 147	
AND	THIS TEST IS TO DETERMINE HOW FILL EFFECT OF A MILL EFFECT OF A MILL TARY-ADDURING A MILL HOUSE SYSTEM RECORDING OPERATOR WILL HAS SPEED AND LOAD FILL HOUSE OND TION.		0040	388 177 83.6 0.471	٠,	25.64 0.36 48.3 227	240 242 1119	1940 ·	82 80 79 253	240	242	86 119 142	
RESEARCH	THIS PURING DURING THE THE THE SYNET THE SPEET		0000	358 177 89.9 0.507		27.83 0.44 49.22 2227	240 243 119 18	16.13	83 81 270	227	243	1119	
COMMAND			MH UNI OM MA MA	18/48 18/48 18/48 18/48	DEG F H20	: 114	7 DEG DEG 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	DEG T	0000 0000 0000 7777	DEG F DEG F	DEG F	DEG F DEG F 1P DEGF	
T S ARMY TANK-AUTOMOTIVE C	SERIAL NUMBER 176482— MODEL DT-466 MODEL DT-466 SPECIAL PROGRAM CODE I H. /FIRE RARDANT FUEL INITIAL CELL ASSIGNMENT I. COMPRESSION RATIO-16.3 TO ORDER NUMBER CUSTOMER NAME SPECIAL INSTRUCTIONS		333	120 TORQUE HORSE POWER 143 BRAKE HORSE POWER 145 BSFC CONSUMPTION LB 145 BMFP	CRIT 003 AIR AFT 082 AIR AFT	AIR AFT. TURBO BLOW BY, CRANKCASE OIL, ENGINE GALLER OIL, ENGINE GALLER		COOLANT, ENG. OUT EXH. AFT. TURBO EXH. AFT. TURBO S	001 AIR, AMBIENT 002 AIR, B4 CLEANER 003 AIR, AFT, CLEANER 004 AIR, AFT, TURBO	006 0IL, ENG. SUMP 007 0IL, ENG. GALLERY	TURE	011 FUEL, BY ENG. FILTERS 011 FUEL, AFT, FILTERS 012 FUELSPILL INJ & PUM	

<u>۔</u> ا	ن ن	ن ع	<u>.</u>	د	٠. ٠		ن	. د	ز.	و	J	ِ الت
15:31												
11/04/86	0010 0100 0100	020 017 141	0651 0652 0653 0653	067 068 069		136 081 082 083	090	084 086 086	108	104	'	103 EQ.
176482	196 DEG F 204 DEG F 59 DEG F 9519 DEG F	199 DEG F 200ENTRY 3	1022 DEG F 1022 DEG F 1087 DEG F 1005 DEG F 883 DEG F	1067 DEG F 1037 DEG F 907 DEG F		29.98 Hg -1.15 H20 -10.58 H20 -23.40 H20	24.50 Hg 0.00 H20	24 41	17.9 PSI 1.11 PSI	9.0 PSI 17.1 PSI	2.2	49.3 PSI
SERIAL NUMBER:	82 87 -175	197 200	8888888 788888	106	-	29.98 -0.01 -0.05	-1.48	H 604	5.9	10.6	[• •	-1.1
SERIAL	195 203 599 139	199 200	9892 9892 903 803 813	919		29.98 -1.15 -2.68		6.64 2.42	29.3	9.9		36.2
DATA	205 205 8427	76 199 200	1001 9556 957 957 854	1047 986 953		29.98 -1.16 -3.42 -6.75	0, 0,	0.63 9.03 3.54	29.3	9.7	ໝາ	40. 8
TEST CELL	195 206 58 8306	199	958 1034 9892 9895 875	1086 1024		29.98 -1.14 -4.49	့ ၈	0.97 12.49 5.20	16.6 0.98	15.4	on ດີເກ	43.8
CENTER	194 205 56 180	80 197 200	972 1053 1017 1017 900 900	1100		29.98 -1.15 -12.76	ຕຸດ	N ID (I	12.9	9.3	ໝູ່ທໍ່ .	45.8
ELOPMENT	195 204 * 555	197 200	1066 1086 1030 1022 1024 917	1113 1068 962		29.98 -1.15 -7.62 -16.79	က္ဝ	4 40	12.4	9.0	ຜູ້ທຸ	47.5
AND DEV	194 203 55 77	197 200	1017 1097 1057 1045 942	1142		29.98 -1.16 -9.47 -20.96	4. W	1.68 24.61 13.00	16.6	8.9 16.6	94	48.3
COMMAND RESEARCH AND DEVELOPM	194 205 57 2884	197 200	1037 11117 1078 1088 1080	1162		29.98 -11.13 -25.36	27.83	V 0-1	18.8	8.6 17.0	04	49.2
OMMAND	DEG	DEG F DEG F		DEG F DEG F DEG F		2200 7220 7220 7220 7220	HG.		PSI	PSI PSI	PSI	PSI
ARMY TANK-AUTOMOTIVE	015 COOLANT, ENG. INLET 016 COOLANT, ENG. OUTLET 018 WATER, TOWER OUTLET	020 DYNO, WATER OUTLET 017 REF. BATH 141 REF. BATH (KEY IN)	061 EXH. PORT #1 062 EXH. PORT #2 063 EXH. PORT #3 065 EXH. PORT #4 065 EXH. PORT #4	067 EXH.B4 TURBO FRONT 068 EXH.B4-TURBO-REAR— 069 EXH.AFTER TURBO		136 BAROMETRIC PRESS 081 AIR, CELL DEPRESSION 082 AIR, B4 TURBO TOTAL 083 AIR, B4 TURBO STATIC	090 AIR, AFT. TURBO 085 BLOW BY, CRANKCASE	BLOW BY, EXH.B4 T	OB FUEL, AFT. FILTERS	04 COOLANT, ENG. INLET	06 WATER, TOWER- 07 WATER, DYNO I	03 OIL, ENG. GALLERY
s n	_			1		C-16			~ ~			

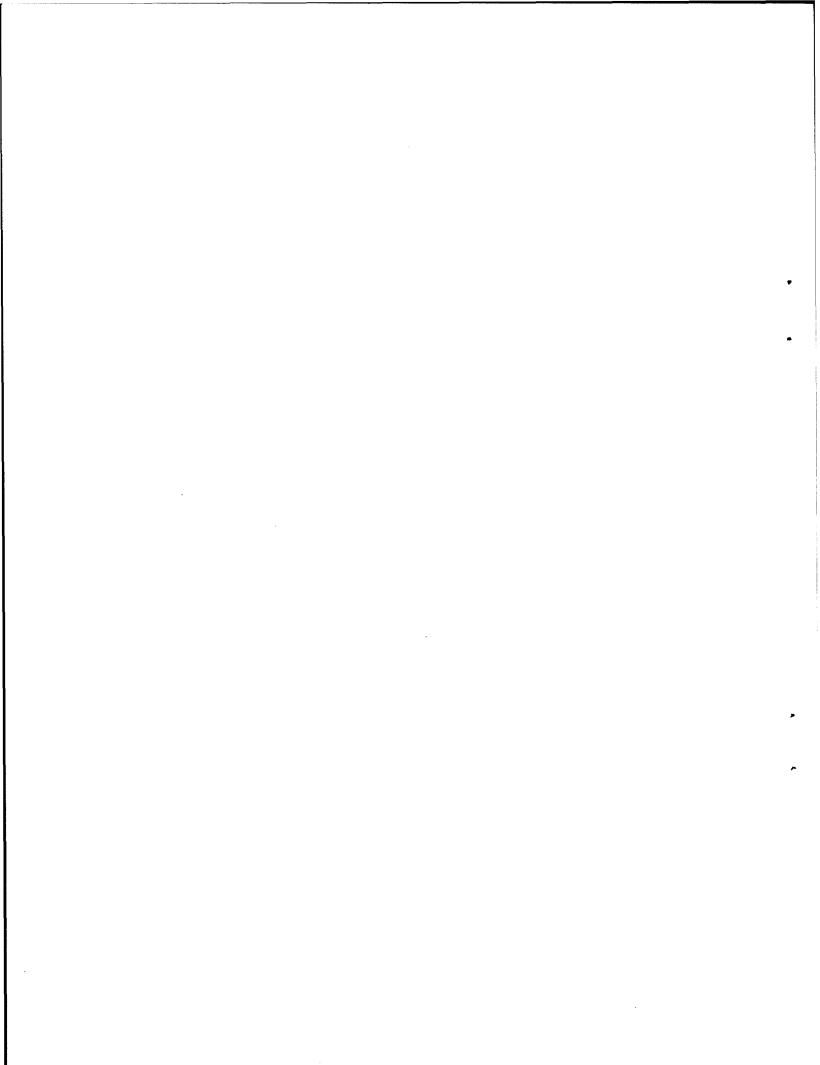
. i.

e	e e e	J	J	·		U .	Ų,				<u> </u>	J	<u> </u>	
	70'K										`			
3: 34	PERFOUNCE: - 2200 70"													
15	PER			E000	244 244 452 44 452 44	8523 8623 8623	0100 0000 0000 0000	0001	980 986 986	6000 1000 1004	9006	800	010 011 012	
/04/86	400 35% FUEL.			GE .	B/HR B/HR SFC	n F			200 rtr	0000 rrrr	EE.	ir F	000 000 000	
11/0	77 L		300	2114	828 828 828 828 838 838 838 838 838 838			223 229 DEG 3.7 PSI		54.17 55.27 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25 55.25	31 DEG 21 DEG	229 DEI	82-DE 19 DE 37 DE	
1	T. P.		27	117	0 1-1846	i,	04	421-E	189	1	223	Ķ.	HH H	
176482	PEP ON		2200 85%	22006	246 66.7 0.456 112.9	71	0000 0000 0000	2234 234 200 200	882 882 8.40	73 73 200 200	234 223	234	120 140 140	
i				\		İ	104)	•	m	hm	
NUMBER	S		12	11,04 9:48 2400	31.7 0.700 32.0	-5.07	222	223 223 121 17.0	4. 98. 9. 9. 9.	132052	227	22	121	
	772 772 NF0		1 1/2-	40m00	2000	270	750 750 750 750 750 750 750 750 750 750	1808	89.4 74.0 74.0 74.0 74.0 74.0 74.0 74.0 74	\$277 \$200	231 222	229	3700 9000	
SERIAL	FHIS PROGRAM TII HOME 77 TICLIFF TECHNICAL INF		3	11,	0.59	• '	64	70-2	6.7	1	NN	N		
DATA	THIS NIEW TO THE THIS NIEW TECHN		12%	1,040 2400 2400 2400	63.07 63.07 63.07 63.07	0.4		12.233 15.233 15.6033	828 9.23	73 72 70 196	235 224	233	120 139	
CELL D	FOR THI		250	-	0 4 4 6 6 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	1 7	71		: !	0000	- 010	_	novα	
TEST CE	P00		12/2	11.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00	74 4 0 4 8 9 15 15 15 15 15 15 15 15 15 15 15 15 15		41 • • • • • • • • • • • • • • • • • • •	237 237 119 16.0	11.3	77.92	ŘŘ.	237	80116	
	TE ANCE LWOOD		13%	1,04 / 8:51 2599	6.05 780 0.00 0.00	66.	22.02	2231 2226 9231 931	199 616 39	71 70 44 144	231	226	121 131	
CENTER	CCHANGE CONTROL OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF THE TENT OF		9	1000	й . С	, iù,	004	-	ດ					
PMENT	MATTANS GUNE MATTANS GUNE MA		1 1/0-	11/04 8:38 2601	53.7 53.7 59.86 59.86	92.0	04 ·U	182233 182133	on⊶	72 69 180	23 5	232	121 135	
DEVELOPM	ELOZ OGU		%					233	40	4000	23¢	37	∞ ∞	
AND D	THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NAME OF THE NA		7	11.75	68.8 0.068		y04 y04	8228	11.3	26	88	23	1128	
	THIS TEST IS TO FILE ROWN FOR A MILITARY-A MILITARY-A MILITARY-A MILITARY-A MILITARY-A MILITARY-A MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILITARY MILI		85%	7.10 7.00 7.00 7.00 7.00 7.00 7.00 7.00	80.56 0.515 0.515	788	25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00 25.00	238 239 17.9	907	70 67 236 236	238 225	239	122 139	
RESE	DETAIL DETAIL DETAIL SYSTI	2	22.			1			-		٠			
COMMAND RESEARCH				EI GEG		DEG F H20	HZO HZO PSI DEG F	000 000 000 000 000 000	DEG F DEG F H20	0000	DEG F	DEG F	DEG F DEGF	
i	FL T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1 - T 1				WER ON LB/	ITS ITAL	w Zyw Zyw	1000	TAT.				TERS S PUMP	
TANK-AUTOMOTIVE	76482 CODE JANT FU IO 16.3	SNO			2 <u>F</u>	POI PNOI	CRANKCAS INE GALLE	30 OUT FILTER	⊑ თ	ANER EANER RBO	MP LLERY	TU0	G-FIL ILTER INU &	
TUT.	ARDAIC ARBANDAIC ARSSI				HORSE	71.F	56.2 66.2 66.1 66.1 66.1 66.1 66.1 66.1 6	5877 047 777		ABIEN CLEN FT. CLE	ENG. SUMP ENG. GALLI	TURBO	BATEN AFT.F PILL	
	2017 HOHE 1	INST		A I I I		IR A	֓֞֞֞֞֞֓֞֞֞֓֞֞֞֓֞֓֞֞֓֞֞֓֓֞֞֞֞֓֓֞֞֞֓֓֞֞	OIL SUMP OIL TURBO FUEL AFT	XH.XX	AIR. AIR AIR. BA	01.1.E	011.11	FUEL: F FUEL: F FUELSF	
. ARMY	. 454575660 I	T I I I		301	11111 00444 000244 14124	003	080 085 007 007 007	00001 0001 00110 00110	015 069 086 86	0002	900	900	0110	
ູ້ທຸ	1100 3000 1		٠	! !		C-:				:				
	~	•						*					*	;

76482 11/07/86 15:06													
-	015 018 019	020 017 141	0063 063 063 064 065	067 068	690	136 081 082 083	060	085	091 086	108 101	105	105	103
SERIAL NUMBER	201 DEG F 204 DEG F 58 DEG F 201 DEG F	, 111	623 DEG F 660 DEG F 638 DEG F 621 DEG F 572 DEG F		599 DEG F	30.19 Hg -1.18 H20 -4.79 H20 -13.32 H20	5.36 H9	-1.33 H20	13.23 Hs 4.97 H20	21.6 PSI 0.97 PSI		15.1 PSI	49.8 PSI
DATA	200 200 200 200 200 200 200	199	666 7186 690 683 683	758	699	30.19 -1.17 -4.59 -12.69	7.15	0.38	13.25 5.08	18.8 0.89	8.7	68.6 14.5	49.3
TEST CELL	203 57 199	72 199 199	822 887 852 872 871 860	936	811	30.19 -1.18 -5.89 -16.69	15.11	0.89	18.44	18.2	17.0	14.5	48.9
CENTER T	196 204 197	199 199	1028 1028 985 985 986	1078	918	30.19 -1.16 -7.20 -21.14	22.97	0.09	24.68	18.0 0.88	8.9	68.6 14.2	48.5
DEVELOPMENT (196 204 2761	1999	1039 1079 1082	FRO	0	30.19 -1.17 -8.26 -24.62	29.00	0.50	28.99 14.08	17.7	17.0	68.6 14.2	48.3
AND DEVE	199 204 200	199	6228 6534 6459 6459	o ⊶ co	(0)	30-19 -1:17 -3.91 -10.49	5.15	-1.20	10.75	15.9	9.0	68.5 14.6	49.2
RESEARCH	199 205 58 201	199	7 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8	4 - 4	0	30-19 -1.16 -4.86 -13.52	12.14	1:00	15.07	15.5	9.0	14.3	48.7
COMMAND R	0000 0000 0000 0000	DEG 7		i	2 2	1220 1220 1220 1220 1220 1220 1220 1220	HG.	H20 H20	NED HG.	P PSI	PSI	PSI	PSI
S ARMY TANK-AUTOMOTIVE CO	015 COOLANT, ENG. INLET 016 COOLANT, ENG. OUTLET 018 WATER, TOWER OUTLET 019 WATER, TOWER OUTLET	017 REF. BATH (KEY IN)	46344 46344 10044	66 EXH. PUKI # 67 EXH. B4 TUR	9 EXH. AFTER TURB	136 BAROMETRIC PRESSION 081 AIR CELL DEPRESSION 082 AIR B4 TURBO STATIC 083 AIR B4 TURBO STATIC	90 AIR, AFT. TURBO	085 BLOW BY, CRANKCASE 084 BLOW BY, CAL: ORIFICE	EXH. B4 TURBO(COMBI	FILTERS INJ & PUM	900	105 WATER, TOWER INLET	03 OIL, ENG. GAL

APPENDIX D

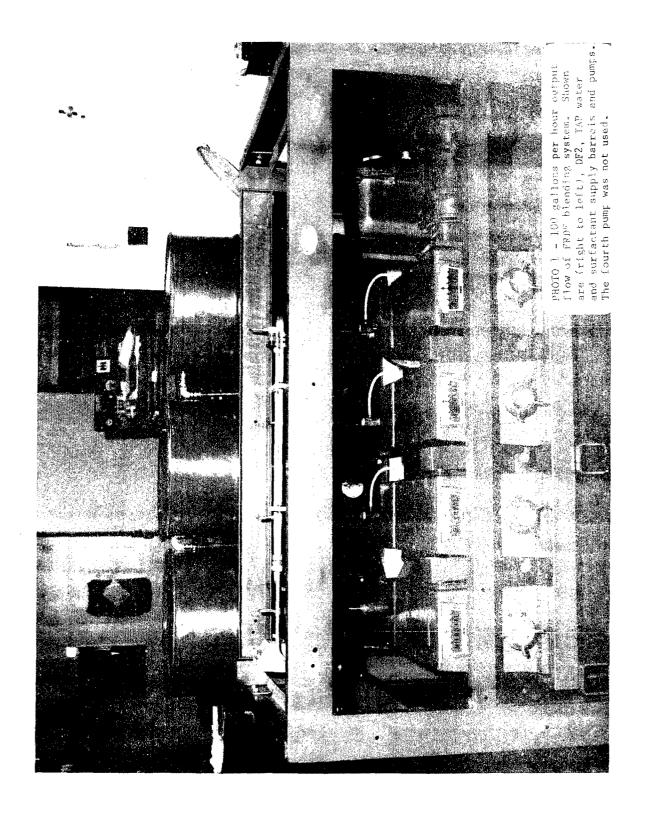
PHOTOGRAPHS

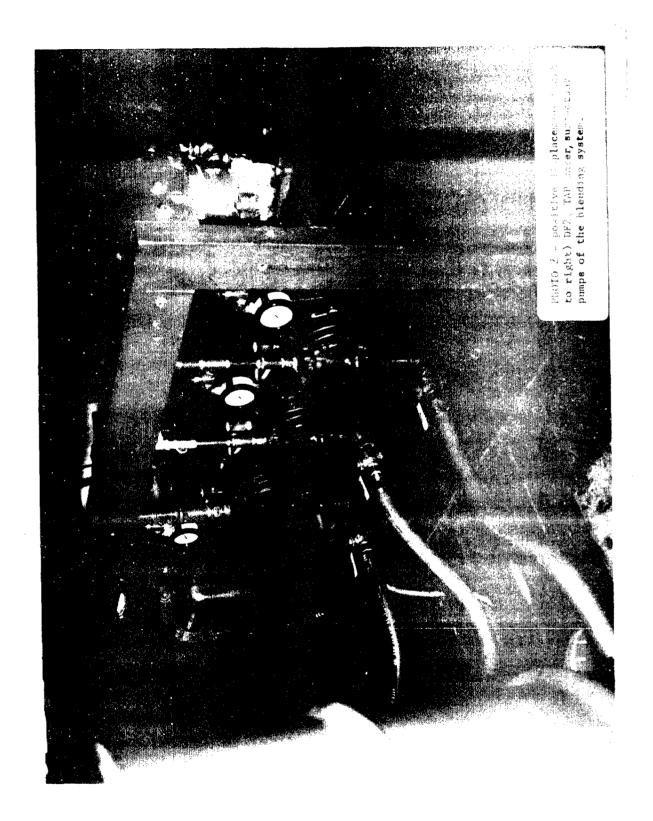


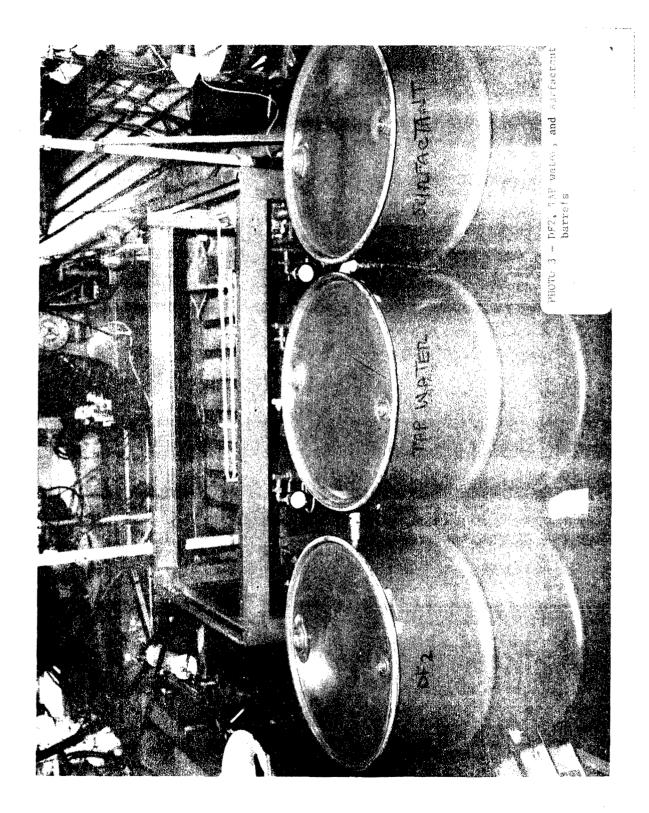
LIST OF PHOTOGRAPHS

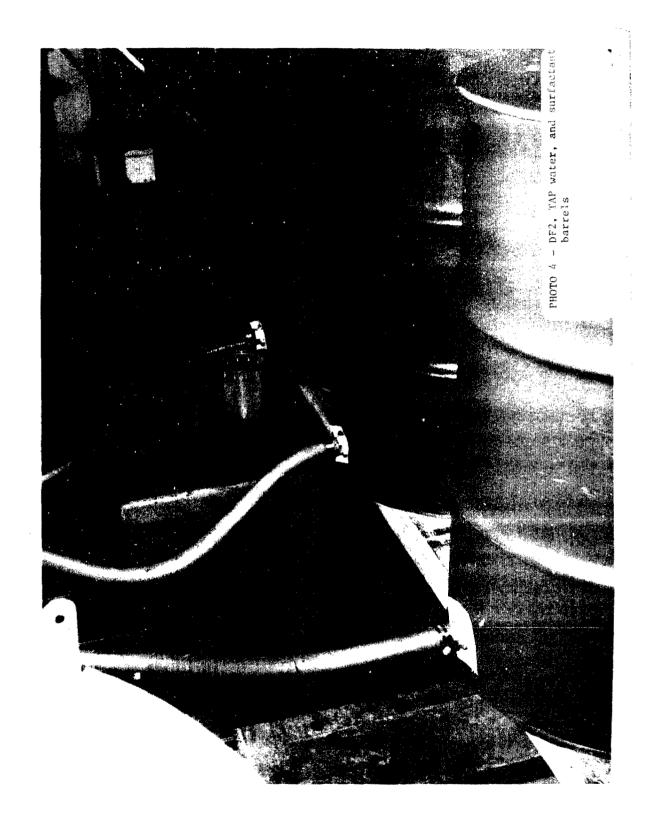
	PHOTO	TITLE	PAGE
1.		100 Gallons Per Hour, FRDF Blending System	D-5
2.		Positive Displacement Pumps of the blending system	D-6
3.		DF2, TAP Water, and surfactant Barrels	D-7
4.		DF2, TAP Water, and surfactant Barrels	D-8
5.		300 Gallon Storage Tank	D-9
6.		Side view of DT466 instrumented engine	D-10
7.		Front View of DT466 instrumented engine	D-11
8.		Rear view of DT466 instrumented engine	D-12
9•		Instrumented engine with water cooling tower in test cell	D-13
10.		Instrumented engine and Dynamometer	D-14
11.		Instrumented engine and Dynamometer	D-15
12.		Fuel Injection pump plungers in Housing	D-16
13.		Fuel injection pump's barrel and delivery valves parts	D-17
14.		Delivery valve body and delivery valve gasket	D-18
15.		Failed delivery valve gasket	D-19
16.		Nozzle body	D-20
17.		Nozzle body and cap	D-21
18.		Glass beads blasted nozzle body and needle valve	D-22
19.		Test piston, rings and connecting rod	D-23
20.		Test piston, showing carbon deposit	D-24

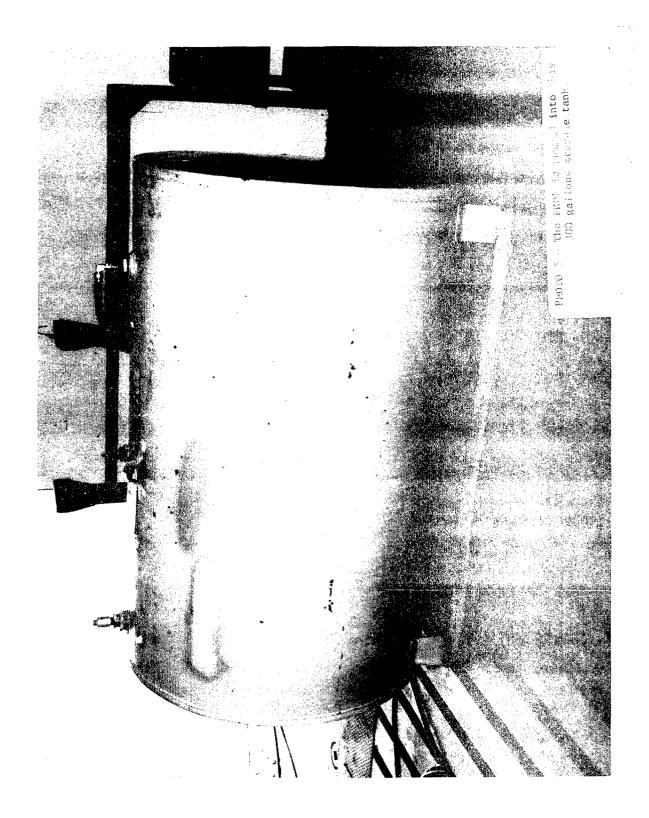
21.	Glass beads blasted piston	D-25
22.	Top view of piston	D-26
23.	Engine Block	D-27
24.	Intake and exhaust valves in cylinder Head	D-28
25.	In-line, 6 plungers and barrels fuel injection pump and governor housing	D-29
26.	Top view of the fuel injection pump plungers and housing	D-30
27.	Nozzle Body and needle	D-31
28	Delivery valve copper gasket	D-32
29.	Barrel, gasket, delivery valve body, spring, washer and holder	D-33
30.	Intake and Exhaust valves	D-34
31.	Intake and Exhaust valves	D-35
32.	Exhaust Manifold	. D-36
33.	Turbocharger, turbine outlet	D-37



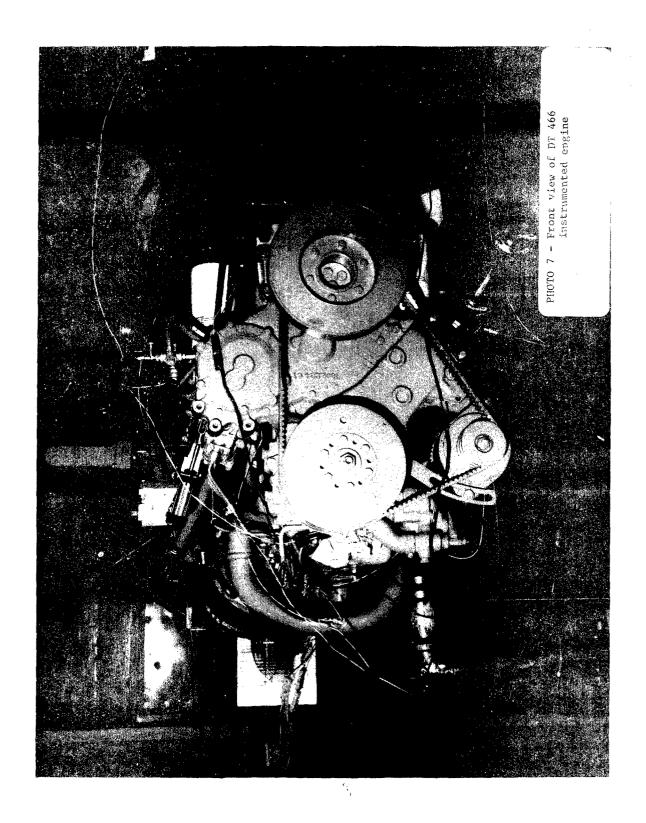


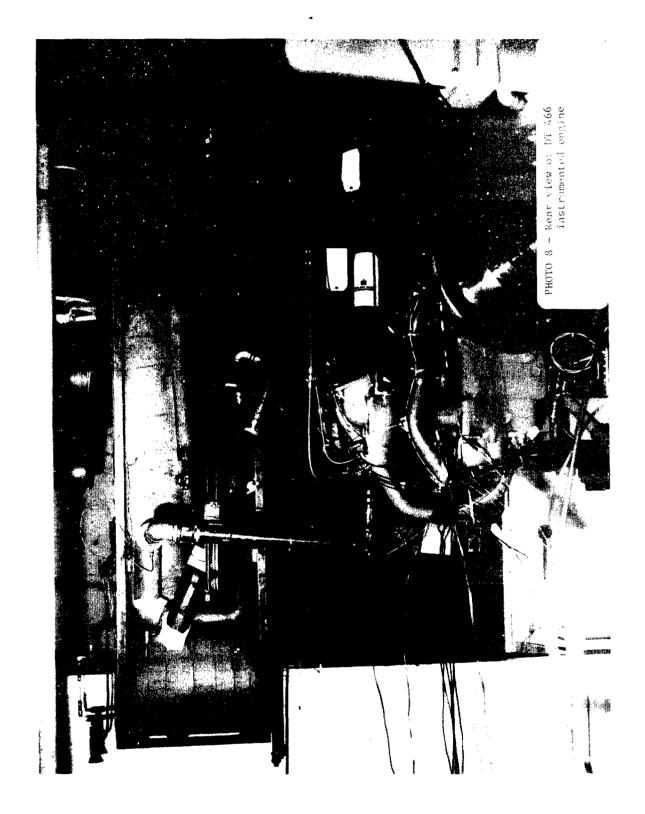


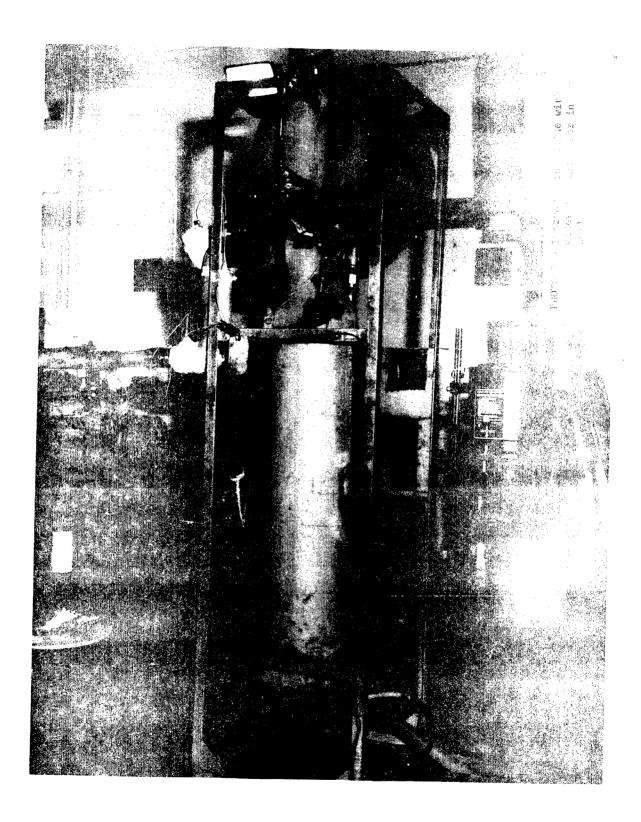


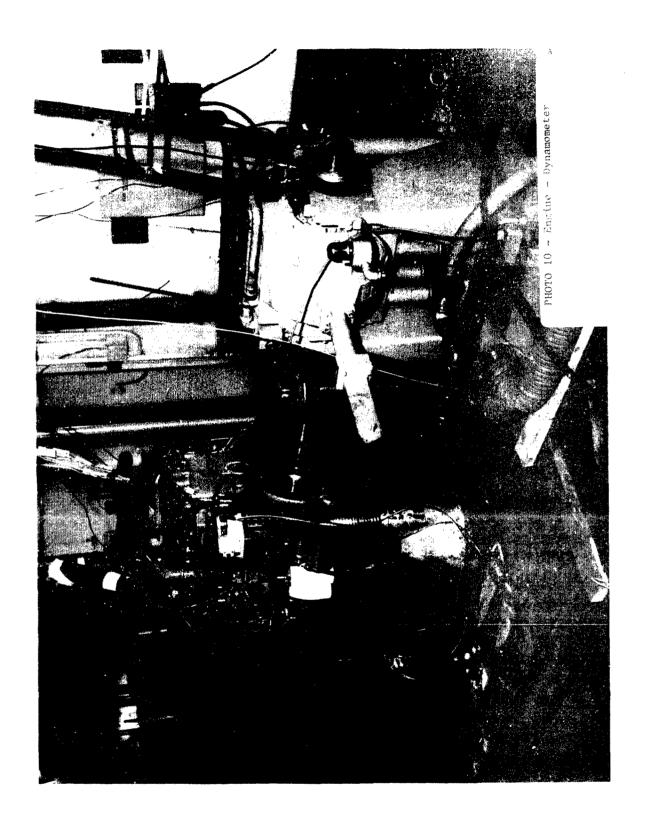


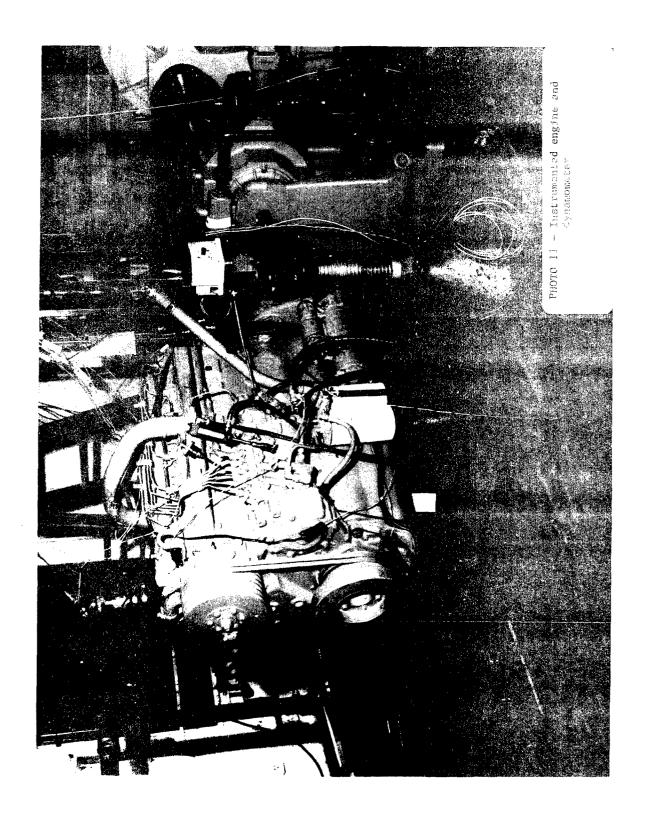


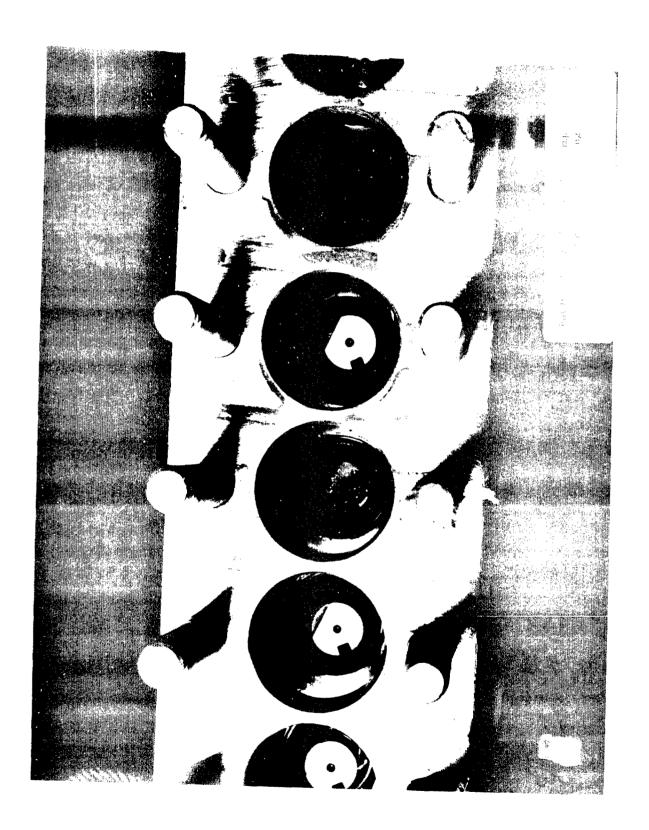












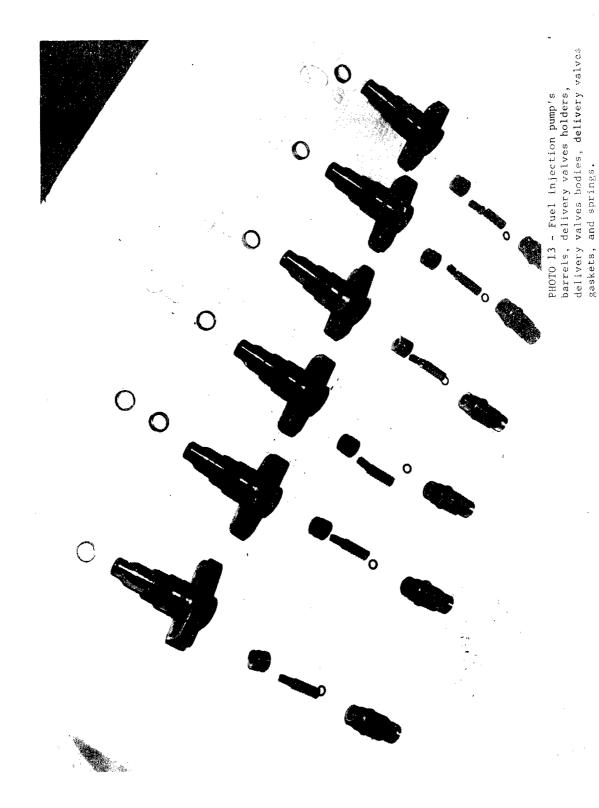


PHOTO 14 - Delivery valve bodies and delivery valve gaskets



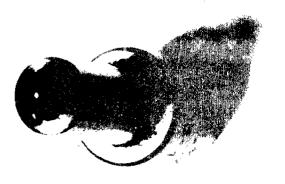


PHOTO 16 - Nozzie bodies





PHOTO 17 - Nozzle body and nozzle cap nut, third front, typical

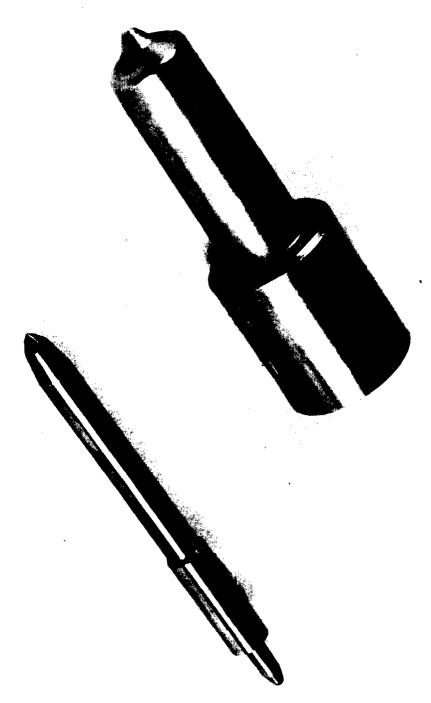
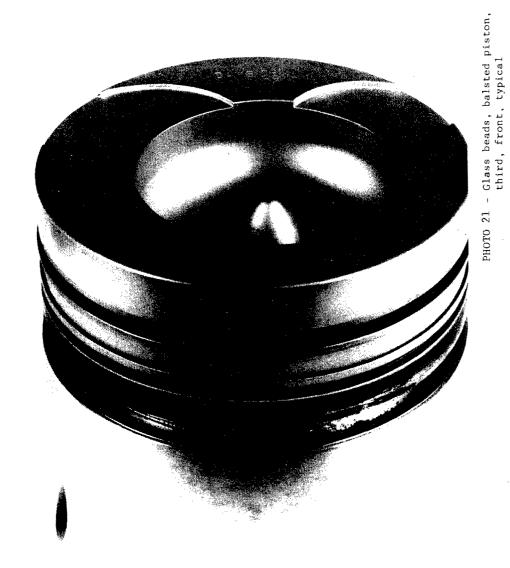


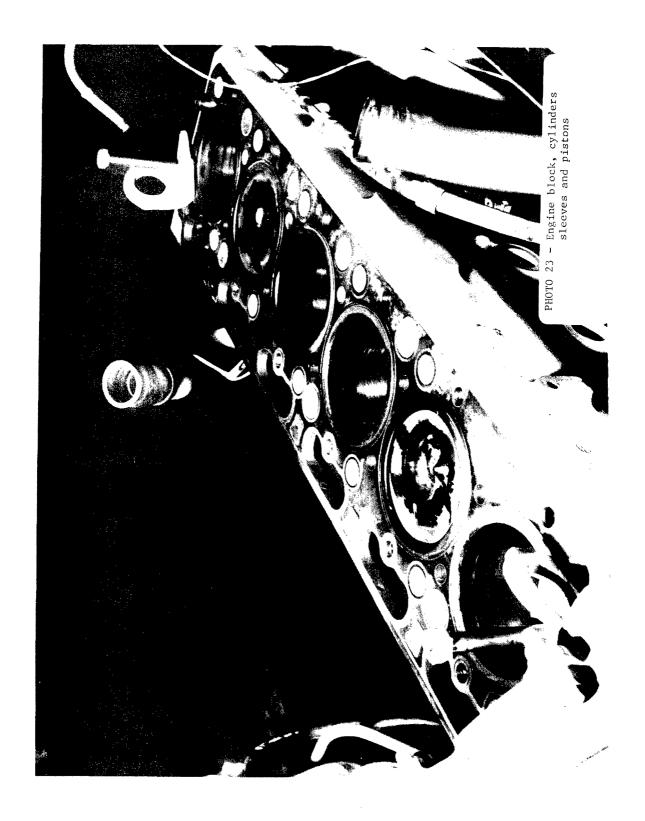
PHOTO 18 - Glass beads blasted nozzle body and needle valve, third front typical











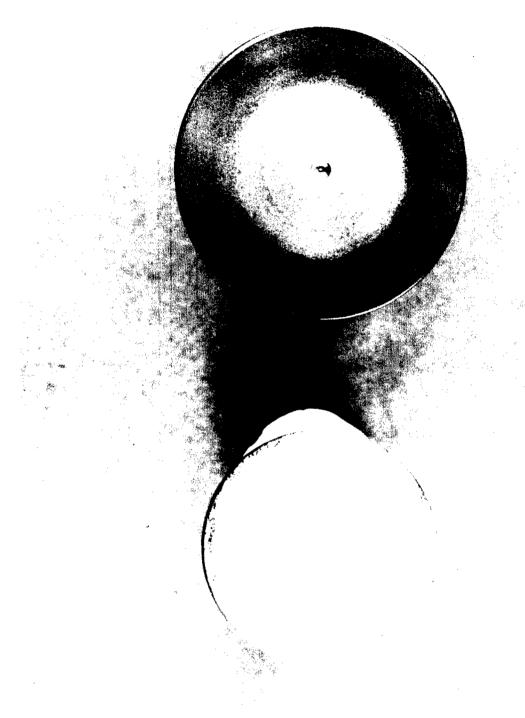
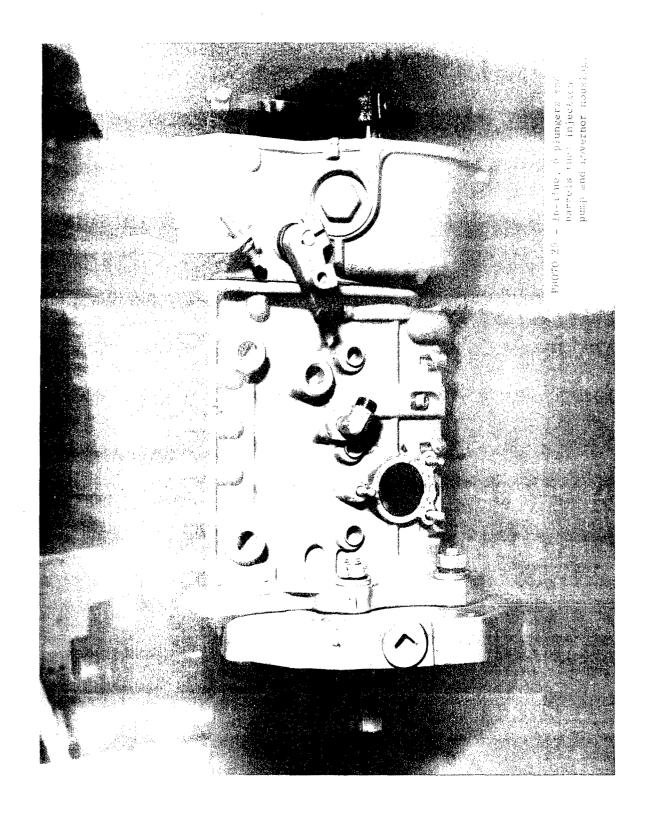
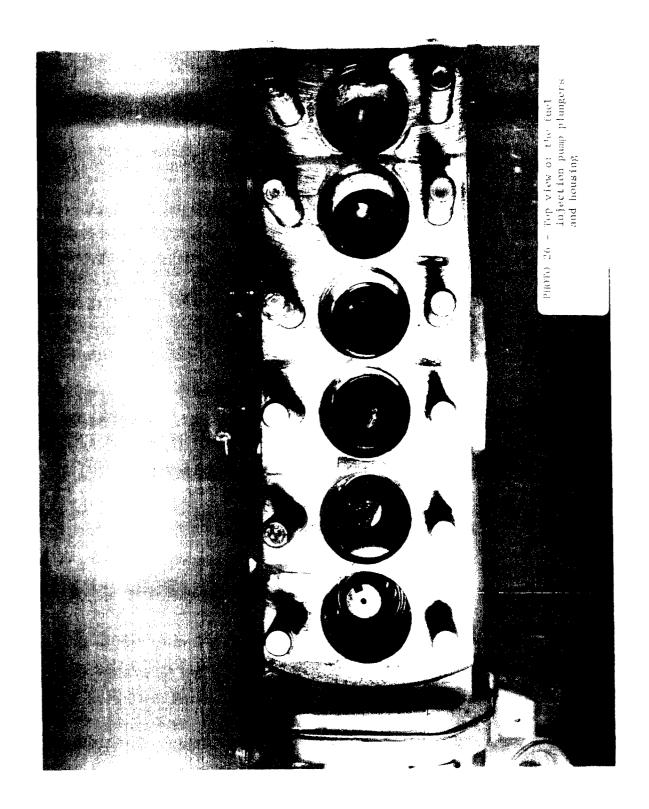


PHOTO 24 - Intake and exhaust valves in cylinder head, bottom view





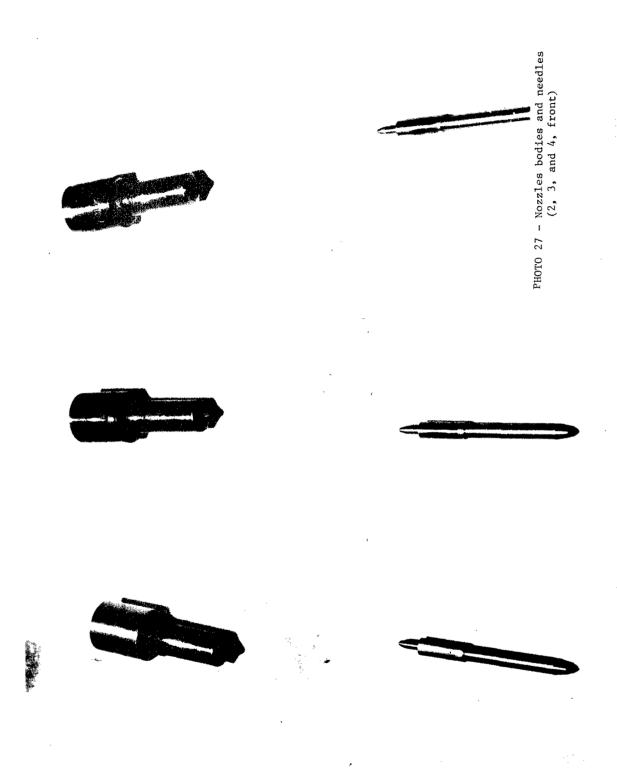


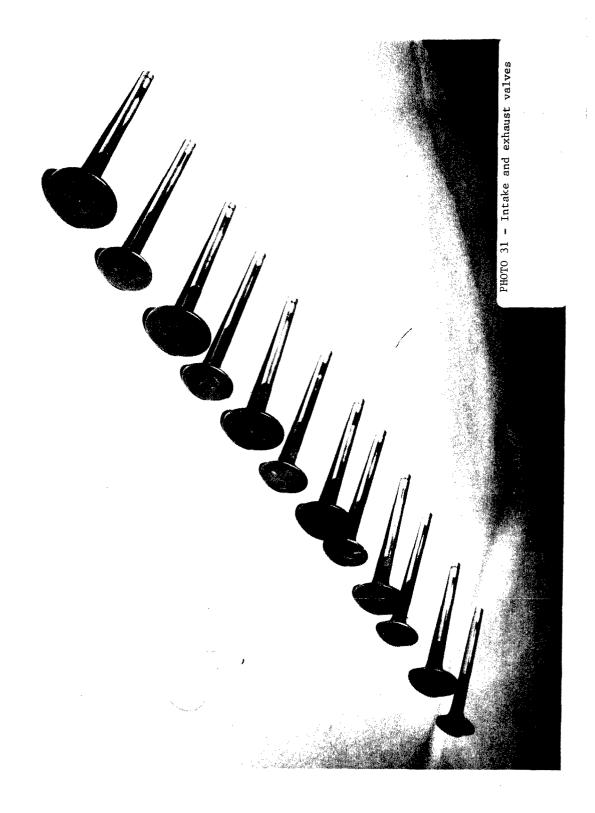


PHOTO 28 - Delivery valve's copper gasket, failed after 388 hour endurance testing.

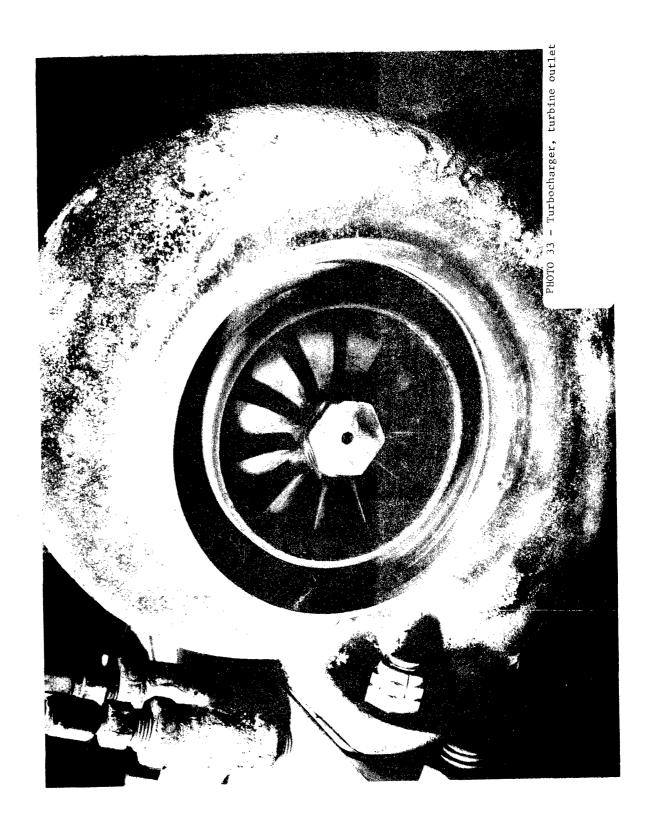


PHOTO 29 - Barrel, gasket, delivery valve body, spring, washer, and holder







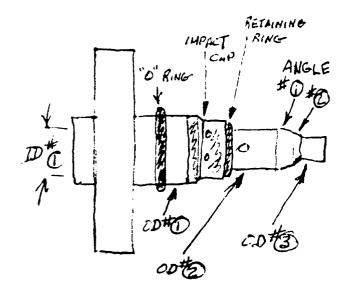


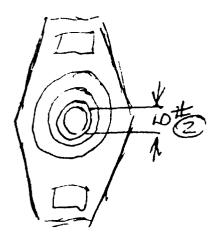
			-
			·
•			•

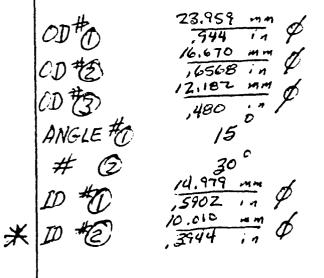
APPENDIX E
DIMENSIONAL ANALYSIS

AMSTA-QAA G.GREMBOS/45979

46		VISUAL SURFACE
Pelivery Lake Body. ANGLE ANGLE	L ,4724 1.11 OD .5444 1.11 **ID .7368 1.11 ANGLE 45	16 12 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8
Polivery Valve Gasket PILT D D A	D 3.984 :4m 7.157 14 0D 14.010 mm 7.552 in 13.654 mm 7.538 in Material 0.177 mm Thickness 7.007 14	









AMSTA-QAD G.GREMBOX/45979



#(6)

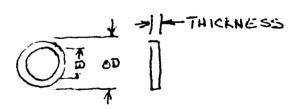
SURFACE FINISH

Delivery Valve Holder

63/ 32/

TO RING TO TO

clasher



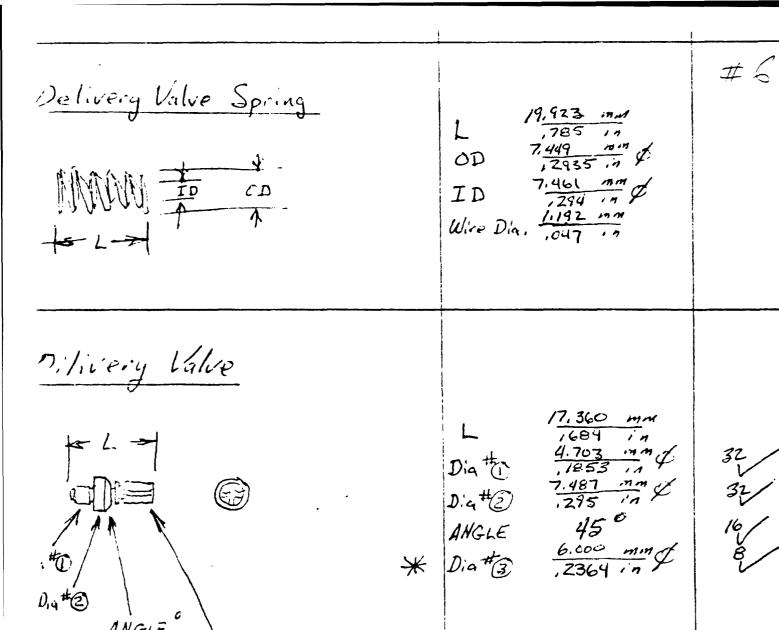
OD 7,801 inm p

ID 4,923 mm

1,194 in p

THICKNESS ,0284 in

32__



AMSTA-QAA GGRENBOS/45979

#5

VISUAL

SURFACE

SURFACE FINISH V

Delivery Valve Holder

CD 13.616 mm \$\phi\$
15365 in \$\phi\$
1D \frac{9.352 mm}{3685 in \$\phi\$

63

MI OD TO

clasher

THICKNESS

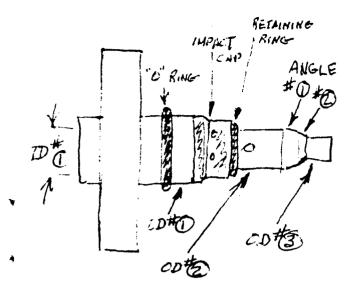
OD 7,791 inm of 1307 in of 194 in of 194 in of 194 in of 1983 in

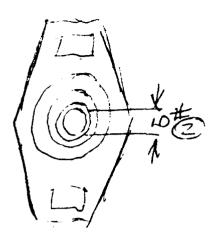
32

AMSTA-QAA GGRENBOS/45979

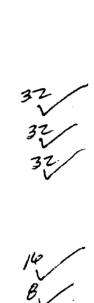
45	A. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1.			VISUAL SURFACE
Delivery Value Body.	*	L CD ID AKGLE	11.987 mm ,47231 m 13.807 mm 1544 in 6.002 mm 723651 m	16/32/32/16/
Plue Gasket DID DID DID DID DID DID DID D		L OD ID Material Tuckness	31807:9m ,150 19 13,832 mm ,545 in 13,553 mm ,534 in 0,177 mm	

Barrel

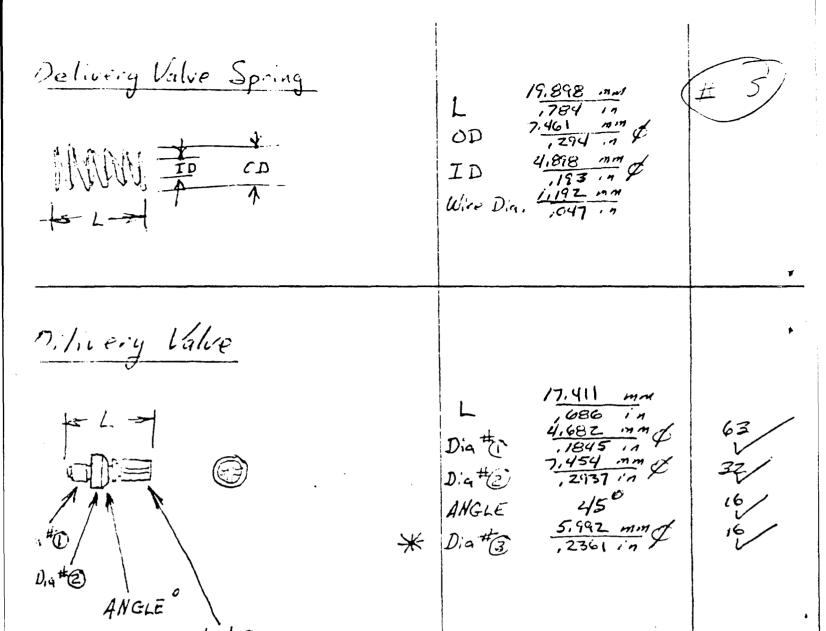


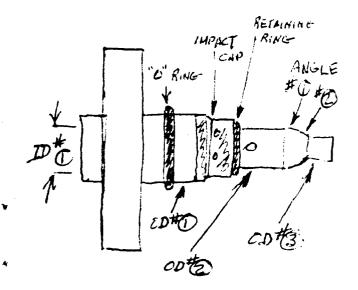


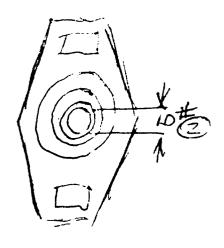
000	23,959 ···m \$
CDE	16.667 mm of 12.187 mm of
CD #3	15° 15°
ANGLE#C	30°
ID #D	14,979 .4m
ID *E	10,005 -11 6



*



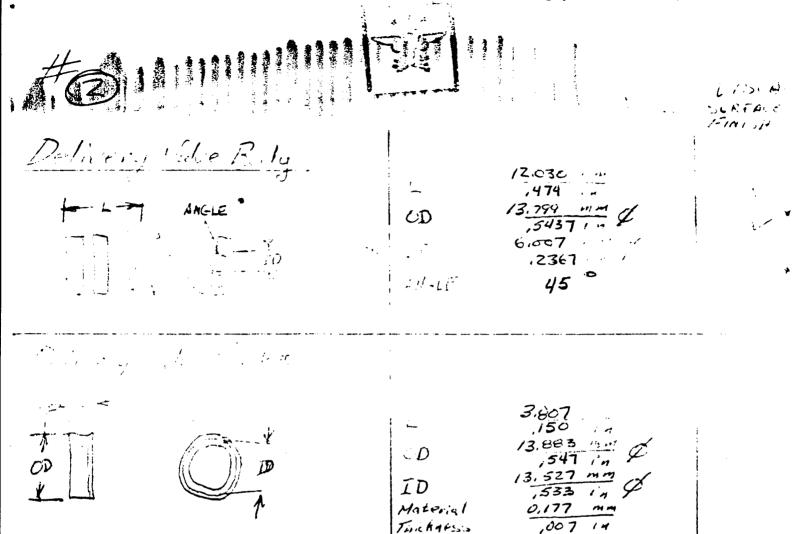






CD#O	23.967 .77
1000	,9443 11 4
in the	16,675 mm
(Dを	1657 in 4
1 .	12.780 mm
(D to	,4803 . 11
ANGLE #	15 5
# 2	30°
10 #70	14.974 44
	,590211
* DE	10,007 AM 6

32 32



AMSTA -QAA G.GREMBOS /45979

#6

SCATACE FINISH

Delivery Valve Holele.

(D) 13.758 mm & 1535 in \$\P\$ 1D \frac{9.350 mm}{3684 in \$\P\$}

63

"c' RINK

CD TD

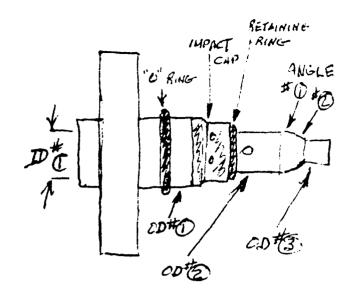
Washer

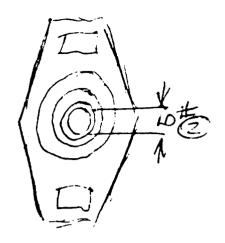
THICKNESS

~ ~	7.817	mm
OD	.308	-inm
TD	7.461	mm
ID	,294	-in B
٠	0.685	m in
THICK HESS	,027	in

32.

Barrel







27#	23,967 .7
CD#C	,9443 11
	16.667 mm pf
CDE	.6567 in
	12.187 mm
(D \$5)	.4802 . 1
ANGLE #	15 E
# 2	30 0
	14,974 MM of
D #0	.5902 11
m that	10.007 mm
D *E	,3443 ,1 4

Delivery Value Spring

A7 A4	<u>¥</u>
mmm =	CD
WWW A	1
- L->	

19.796 .nus
17.80 1.1

7.436 nsm &

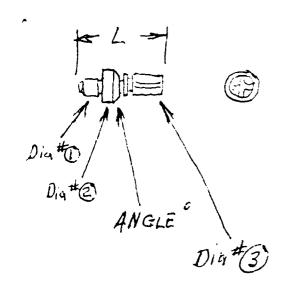
ID 4.873 nsm &

19.792 in &

Wire Dia, 1.167 nsm &

Wire Dia, 1.046 in &

. Dilivery Valve



Dia # 2 17.352 mm (1.695 mm (1.695 mm (1.695 mm (1.785 mm (1.

E-15

63 32

16

16

AMSTA -GAA G.GREMBES /45979

#0				LYSCH SCRFACE FINISH
Delivery Links Budy. ANGLE ANGLE	*	L CD ID AKGLE	12.626	16 32 32 32 32 32 32 32 32 32 32 32 32 32
Delivery lalve Gasket TILE OD T T T T T T T T T T T T T		CD ID Material Thickness	3,807 MM 150 In 13,908 Mm & 548 In 13,553 Mm 1534 In 0,177 MM	

AMSTA GAA G. GREMBUS/45979

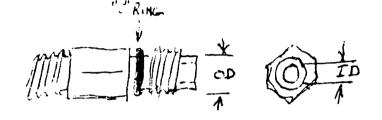


VISUAL SCATACE FINISH L

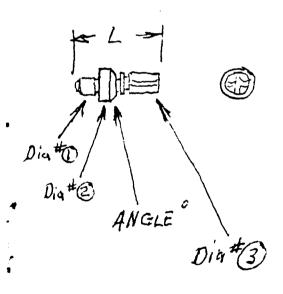
Delivery Lalve Holeler

CD	13,758	Mm 10	Ø
ID	9.35Z ,3685		

63



Dilivery Valve



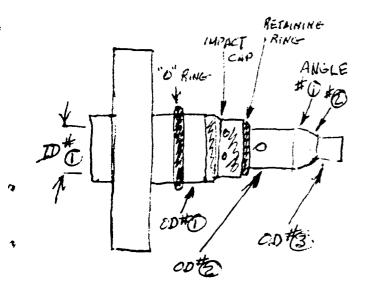
L	.681 11
Dia to	1843 1.1 EP81.
D:4#2	,2923 in
ANGLE	450
D:a#3	,236Zin 9

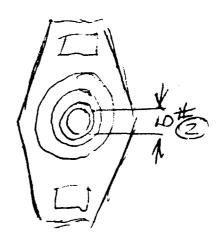
AMSTA - 914 G. GREMBOS/45979

#(3)			WASCA!
Delivery Value Body	L CD * ID AKGLE	12.000 mm f 14728 1 m 13.814 mm f 15443 1 n 6.010 mm f 12368 1 n	1622 Bi 8
Delivery lake Gasket TILF OD D D A	L CD ID Material Thickness	3.807 19M 13.908 19 19 13.563 19 19 15.563 19 19 0.177 19 19	

Barrel



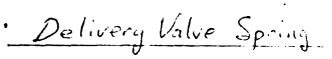


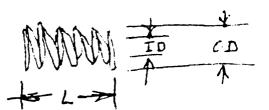


(D (3)	190 mm d 4803.n
# 0 14.5 D #0 14.5	15° 30° 179 mm d 702 11 p

32/

*

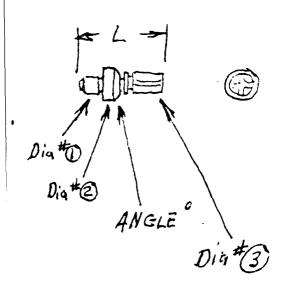




	20,00 inul
L	1788 11
OD	7.436 mm x
ID	4.873 mm /
<i>L</i> D	
11/2 21	1.218 MM
Wire Dia.	.048 .7



Dilivery Valve



Diato Diato ANGLE	17.335 MM
Dia #3	5,997 min of ,2363 in

*

COMPONENT NAME FUEL IN NOZZLE	JECTION	INSPECTION	REPORT	SCHOST NOWS	PART #6	
MANUFAC TURER				STELAL NUM	STREAL NUMBER	
PART NUMBER		DRAWING NUMBER		REVISION DA	TEER	
REVISION NUMBER	Ex. OR	DER HUMBER	JOS GROER NUM	48ER	DATE COMPLETED	
PRESCRIBED DIMENSION	,	ACTUAL DIMENSION	CUT OF	TOLERANCE	REMARK S	
.0137 & 4PLCS.	(1)	.0137		·	NO CARBON	
· .	(2)	.0137			APPEARING O	N
	(3)	.0137			THESE 4 hole	e s
	4	.0137				
NOZZLE PARTS						
FOR #6					·	
					·	
PART #ADB-15.4-265	- 7				-	
LARGE	. 57	5 .				
SMALL 8	.355	/.359			•	
HOLE 8	.17	74				
				_		
	_					
		·				
		·				
			-	24		
				7		
INSPECTOR		x 8 1 575 3007			PAGE NO. NO.OF	PGS.

17A Form 23 1 Dec 82

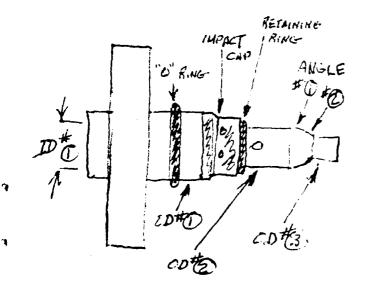
PART # 6

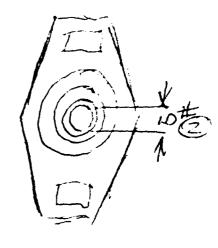
AMSTA-GAA G GREMIZOS /45979

VISUAI SURTACE FINISH L Delivery Valve Holder OD 13.604 mm p 1536 in p 10 9.355 mm p Washer OD ID 4.923 mm 6

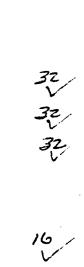
194 in 6

741CK NESS 0.710 mm



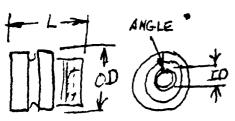


OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO OD TO	23,959 .7m ,944 in \$ 16,004 mm { ,6566 in \$ 12,190 mm { ,4803 in \$
# © 10 *O 10 *E	14,979 mm ,5902 11 \$ 10.012 mm ,3945 11



#(4)

Delivery Value Body

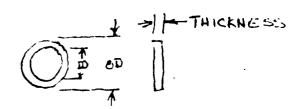


		11,959 mm
	<u></u>	,4712 14
	OD	13.819 mm 0
*	ID	6.002 mm
	ANGLE	45

VISCH.

*

(clasher



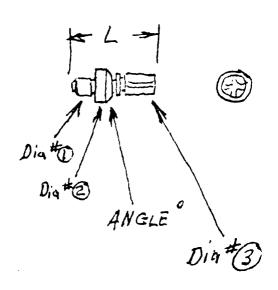
OD 7.817 mm/
1308 19 4.923 mm/
110 4.923 mm/
194 in 6
0,710 mm
1028 in

32

Delivery Valve Spring

19.847 inm 7.82 in 7.449 nom 7.449 nom 7.449 nom 7.449 nom 7.498 nom 10 4.898 nom 193 in Wire Dia, 1.167 nom

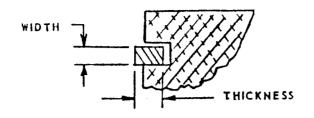
Dilivery Valve



Dig # 2 7.487 mm (x ANGLE 45 Dig # 3 7.487 mm (x 295 in x 450 100 # 3 1.2363 in x

PISTON RING THICKNESS AND WIDTH (LAB. SOP.)

2 1 777 177	sheet of l of l				
ENGINE NO. 466T2	WORK ORDER				
RECORDED BY	CHECKED BY				
MLEANSHEK	MELANSHEK				



	·			······································				 _					
CYL.				THICKN RING			WIDTH RING NO.						
		TOP	2	3	4	5	6	TOP	2	3	4	5	6
	MAX.	.176	.175	.180	.174	.180	.182	.117	.115	.114	.115	.115	.117
#1	MIN.												
	MAX.	.176	.177	.177	.178	.178	.179	.116	.116	.116	.116	.116	.117
# 2	мін.												
	MAX.												
	MIN.							ļ			ļ		
	MAX.										<u></u>		
	MIN.				·								
	MAX.												
	MIN.					<u>.</u>							
	MAX.												
	MIN.												
	MAX.				_ . 			ļ					
	MIN.				-								
	MAX.										-		
	MIN.												
	MAX.			· · ·						·			
	MIN.	-											
								 					
	MIN.												
	MAX.												
· · · · · · · · · · · · · · · · · · ·	MIN.												
	MAX.	· ·								-		2344	•
	MIN.								<u> </u>		40.		

TAC FORM 4534 F

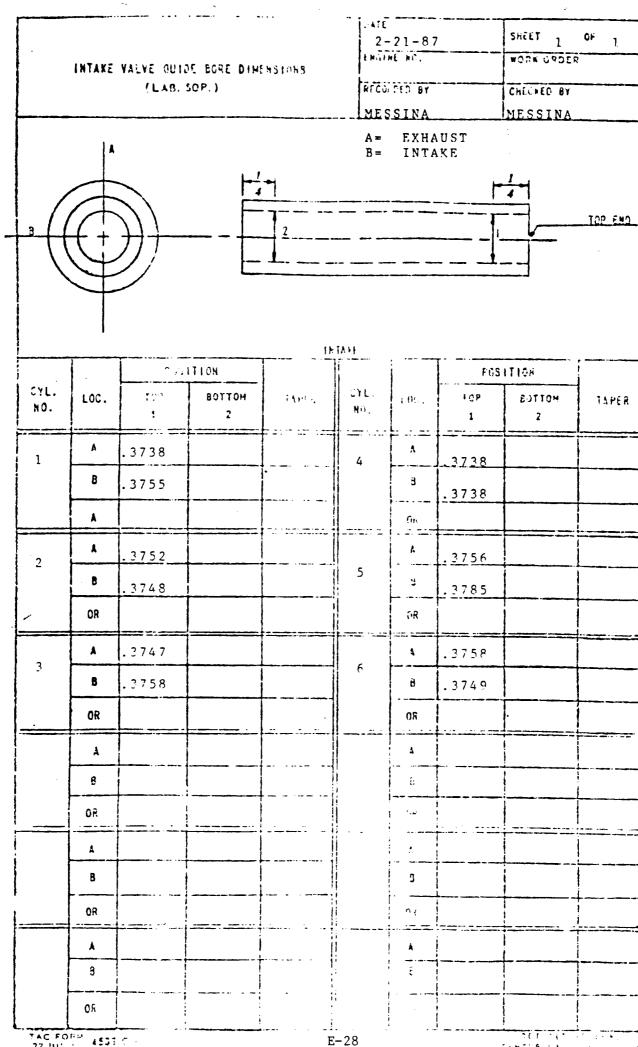
		·						
	2 Y L	INDER	LINER	Roc		25-87	SHEET	OF
	- <i>, _</i> -	ULX	LINER	BOX	ES ENGI	NE NO GTZ	SERIAL	No.
					M. N	NE NO 672 ORUED BY 1ESSINA	R. MELAN	SHEK
		4 –		~~~		•	•	
	/	A PERP	ENIDICULA CRANK_SH	AFT				
] _				* - 6	•			
٤٠	3 (TOP	A EN+ED	, /		-
				41	CENTER	2		
		İ	•	hin	~~~	لمتد		
CYL	102		POSITI	ON		Pro	1174	
NC.	Loc	/	2	3	TAPER	KEI	1ARKS	
,	A	4.3004	4.2006	4,2104		1		
RAC	3							
	OR							-
	A	3005	4.3005	4.3009				
	8							
	OR					1		
	A	1,30(K	4.2005	4.7015				
,	8		-			1		
	OR					†		
	A	3007	4.2008	4.2017				
	B					†	7	
	OR					†		į
	A	3014	4.3608	4.2010				
1	B					†		
	OR					1		
	A	4.2006	4.3008	4.2011		-		
3	B						25 =	EB 1087
						1		- ,557
ļ	OR			<u> </u>	1	ALTERNATION OF THE PERSON OF T		

							· ***		
							1-07	SHEET 1	or 1
E	XHAUST	AND INTAI	KE VALVE ST	ions .	ENGIUE	NO.	WORK ORD	ER	
-			(LAB SOP)		RECORDE MESS		CHECKED BY MESSIN		
	<u>A-1</u>	8-1) - E	8-1	MEASURE GUIDE TRA			EXHAUST NTAKE	
CYL.	LOC.	PO:	SITION 2	TAPER	CYL.	LOC.	POS	ITION 2	TAPER
£x н. ∮ 1	B OR	.3720	3717		EXH.	A B			
INT.	B OR	3720	.3720		INT.	OR A B OR			`
EXH.	B OR	3720	.3719		EXH.	A B			
інт. * 2	A B OR	.3720	.3720		INT.	A B			
€ XH.	A B OR	.3720	.3718		EXH.	OR A B			
INT.	A B OR	.3718	.3719		int.				
EXH.	A B OR	.3720	3715		EXH.	OR A B			
INT.	A B OR	.3720	.3720		int.	OR A B			
EXH. 1 5	02 02	.3721	. 3715		EXH.	OR A B			
INT.	A B OR	.3719	.3718		INT.	OR A B			
EXR. , 6	A 3 OR	3720	3718		EXH.	OR A B			
INT.	A	.3717	. 3717		INT.	OR A B			

TAC FORM 17 AUG 4533

E-27

DETROIT ARSENAL CENTER LINE, WICHIGAN



COMPONENT NAME FUEL INJECTION NOZZLE		INSPECTION		PART #1			
MANUFAC TURER		·	STEIAL NUMBI	STEIAL NUMBER			
PART NUMBER		DRAWING NUMBER	,	REVISION DATEER			
REVISION RUMBER	£X. 98	DER HUMBER	JOS ORDER NUI	#OER	DATECTIO	LETEO S	
PRESCRIDED DIMENSION	,	ACTUAL DIMENSION	OUT OF	TOLERANCE	RE	MARK S	
.0137 O 4 PLCS	(1)	.0312					
	(2.)	0312					
	(3.)	. 0312					
	(4)	.0312					
~							
					·		
	-	T				-	
		-					
PART ADB-150M-208-	7						
LARGE / 8		575 -	,				
SMALL &	.356	/.357					
HOLE 9	. 17	7 5					
	:		•				
NEEDLE PIN &	. 1	773	1				
			,				
			1				
			:			- XX	
INSPECTOR		1 FED AL.		*************************************	PAGE NO.	NO.0F	

DTA Form 23 1 Dec 82

COMPONENT HAME FUEL INJE NOZZLE MANUFACTURER	CTION	INSPECTION	REPORT	Z-ELAL NUMB	PART #5	
PART NUMBER		DRAWING NUMBER		RIVISION DATEER		
REVISION NUMBER	EX. OR	DER NUMBER	109 070ER NU	MBER	DATE COMPLETED	
PRESCRIDED DIMENSION		CTUAL DIMENSION	OUT OF TOLERANCE		REMARKS	
.0137 4 4PLCS	_0_	.0132				
	(2)	.0132				
	<u> </u>	.0132				
	4	.0132				
					•	
<u> </u>						
						·····
· ·	 	-				
PART #ADB-150M-208	- 7					
LARGE	.57	5				
SMALL &	355	/358				
HOLE	.17	7.5				
NEEDLE PIN		17.73				_
	-					
			general	Carrie Carrie		····
INSPECTOR RICHARD ME		81 : 1997			PAGE NO.	NO. 0F

UTA Form 23 1 Dec 82

PART

COMPONENT NAME FUEL INJE	CTION	INSPECTION	REPORT	BOROBE HOMB	PART #3			
MANUFAC TURER					STALAL NUMBER			
PART NUMBER		DRAWING NUMBER	REVISION DA	RIVISION DATEER				
REVISION RUMBER	EX. OR	DER NUMBER	JOS ORDER NU	MBER	DATE COMPLETED			
PRESCRIDED DIMENSION	A	CTUAL DIMENSION	OUT OF	TOLERANCE	REMARKS			
and the second section of the second section of the second section of the second section of the second section of the second section of the second section of the second section of the second section of the second section of the second section of the second section of the second section of the second section of the second section of the second section of the second section of the second section of the second section of the second section of the second section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the section of the s	ļ			The State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the State of the S				
.0137 6 4/PLCS	1	.0132						
	(2)	.0132						
	3	.0132						
	4	.0132						
	<u> </u>				·			
NOZZLE PARTS	ļ							
FOR PART #3	SHIMS ARE MISSING					 -		
				· · · · · · · · · · · · · · · · · · ·	·			
PART #ADB-150-208-7								
LARGE		75						
SMALL /	.355/	.357	1					
HOLE	.17.7	'4		-				
	,					· 		
NEEDLE PIN		1773						
	-							
			and appearance of	* E				
INSPECTOR					PAGE NO. NO.O	FPGS.		
RICHARD MELAN	SHEK	8 1 FED 1987	Ph	u.	1 1	•		

DTA Form 23 1 Dec 82

PART #3

COMPONENT NAME FUEL INJECTIONOZZLE MANUFACTURER		INSPEC	TION	REPORT	PART #4			
PART NUMBER		DRAWING NUMB	(A	REVISION DA		TEER		
REVISION NUMBER	EX. OR	DER NUMBER		J08 080ER NU	MBER	DATE COMPLETED		
PRESCRIDED DIMENSION	ACTUAL DIMENSION			OUT OF	TOLERANCE	REMARKS		
.0137 .0 4PLCS	1	.0132						
	3	.0132	8				· · · · · · · · · · · · · · · · · · ·	
	4	.0132	م					
"OZLE PARTS								
FOR #4	SHI	MS ARE MI	SSING					
ART #ADB-150M-208-7		5 7 5						
SMALL S		5/.358						
HOLE 9	. 1	774				-		
NEEDLE PIN	.17	7 3						
				2 *	\$			
RICHARD MELA	NCUFV	0 1 5	_		A.	PAGE NO.	1	

¹A Form 23 1 Dec 82

PART #4

COMPONENT NAME FUEL INJECTIONS	INSPECTION REPORT			terotet kom	PART #2			
MANUFAC TURER				STELAL NUP	STELAL NUMBER			
PART HUMBER		ORAWING NUMBER		REVISION DA	TEER			
REVISION NUMBER	Ex. OR	DER HUMBER	JOB ORDER NU	JOB ORDER NUMBER		DATE COMPLETED		
PRESCRIBED DIMENSION	ACTUAL DIMENSION		OUT OF	TOLERANCE '	R	EMARK S		
.037 Ø 4/PLCS.	(1)	.0132						
	(2)	.0132						
	(3)	.0132						
	4	.0132						
NOZZLE PARTS								
FOR #2								
SHIMS ARE MISSING								
SHIRD ARE HISSING		***						
ART #ADB-150M-208-7								
LARGE &		.575						
SMALL Ø	 	56/.357						
HOLE Ø		774						
. ~								
NEEDLE PIN Ø	. 1	773	- 			•		
Habbar Tin.	·		'					
								
			+					
			•					
			:					
			40577.70					

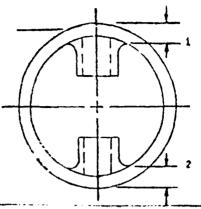
NSPECTOR					PAGE NO.	NO. OF P		

UTA Form 23 1 Dec 82

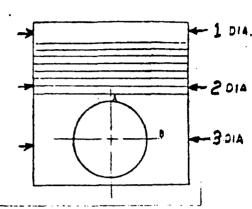
PART

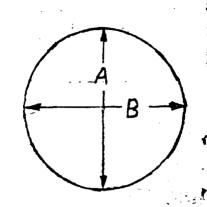
PISTON PIN BORE

DATE 21 Feb 87	SHEET 1 OF
ENGINE NO. 466T2	WORK ORDER
RECORDED BY	CHECKED BY
R. MELANSHEK	R. MELANSHER



is the Lating





	#	PISTON	PIN BORE	TAPER	AVG. DIA	PISTON	00.	1 DIA	2 DIA	I	3 DIA
- 1	1.,	All	56				A	4.2342	A 4.2478	A	4.2933
ě		BI	88				8	4 2460	8 4 2480	В	4 2873
١	_ on	00	ne ne				a	8110.	o4 .0002	OR	.0040
- 1		41	AZ SA				A			A	
1	•	81	Ø2			\longrightarrow	- 18		0	- 8	
		٥٤	S.R.				<u> </u>		GR	OR	
			AZ				A	4 2308	4 2478	A	4:2860
	<i>#</i> 2		38	_		\sim	18	4 2318	6 4 2477	B	4:2950
	CLÉAN	4	104				OR	0010	0001	OR	.0090
1		A1	AZ .				1		A	A	19 1 19 1 .
		81	62				۵	•	8	B	en (1. 4 <u>1</u>)
	-	OR	DA	T -			ON	-	11	OR	
		4	AZ						A	7	1 1. 公路 😭
		81	82				B		8	0	
	_	OR.	of.				OA		ae	08	-
		Al	12		 	K	\rightarrow		A	+	
		61	92		 						~
							6		8	0	
	<u> </u>	of .	04		 		JOK!		on	CR	· .
		A ¹	A2		ļ		A		A	A	
		81	82		<u> </u>	\times	8		10	B	
		0.0	28				ON		CR	OR	
		[41]	AZ	<u> </u>	<u> </u>				Δ	A	i
	}	31	82				A	•	8	8	
		SA	oN				DA		CA	OR	
		Ai	AZ						A	A	
	1	81	DZ.				3			+-+	
		ot	Ot .		 		JOA .	·	B	3	
		Al	12						CA	PR	_
	l	81	62				8		A	4	
	<u> </u>	CA	OF						8	8	· · · · · · · · · · · · · · · · · · ·
		Al	AZ				>100	····	OR	OR	
	l	61	82	The state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the s	 		A		A	A	
	1	OR	ON	*	 		A		8	B	
•	 		12	7771			02		SR.	OR	
•	1	6					1		A .	A	
	1	08	62				8		8	B	
	ļ	19	- 04	C.M.			> 0 A		ar	M	
	1		11	25 FE	1007		11	-			
	I		.11	NO FE	1307						
er k · ·	,	4.4	and and a		Section 1	المواكرة والمعصوب	-11		The second second second		المراجعة المراجعة

DISTRIBUTION LIST

	Copies
Commander Defense Technical Information Center Bldg. 5, Cameron Station ATTN: DDAC Alexandria, VA 22314	12
Manager Defense Logistics Studies Information Exchange ATTN: AMXMC-D Fort Lee, VA 23801-6044	2
Commander U.S. Army Tank-Automotive Command ATTN: AMSTA-CF (Mr. Orlicki) Warren, MI 48397-5000	1
Commander U.S. Army Tank-Automotive Command ATTN: AMSTA-DDL Warren, MI 48397-5000	2
Commander U.S. Army Tank-Automotive Command AȚTN: AMSTA-RGE Warren, MI 48397-5000	12
U.S. Army Belvoir RDE Center ATTN: STRBE-VF Fort Belvoir, VA 22060-5606	2
Belvoir Fuels and Lubricants Research Facility (SWRI) P.O. Drawer 28510 6220 Culebra Road San Antonio, TX 78284	2
Director Army Materiel Systems Analysis Activity ATTN: AMXSY-MP Aberdeen Proving Ground MD 21005-5071	1